ROTUNDA

SUMMER 1978 VOLUME 11 NUMBER 2 $1.50

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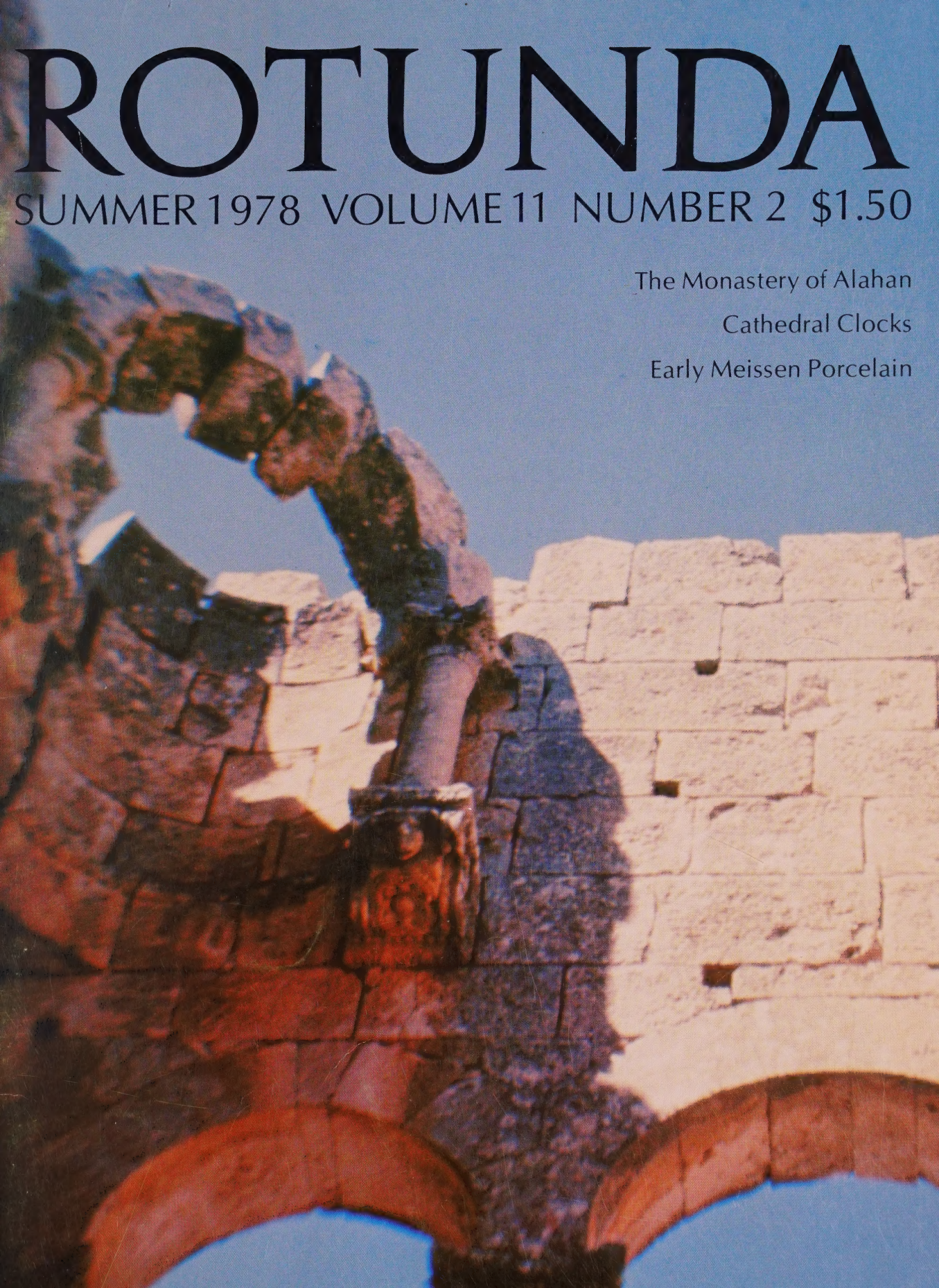
Cathedral Clocks

Early Meissen Porcelain



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ROTUNDA

the magazine of The Royal Ontario Museum

Volume 11, Number 2, Summer 1978

Focus *Jim Lovisek* **2**

They Carved the Stone *Mary Gough* **4**
The Monastery of Alahan

Time in Hours, Days, Years... *Henry C. King* **14**
Cathedral Clocks

The Growing Collections **23**

First Things First *R. E.Barnett* and *D. M. Rudkin* **26**
Aspects of Precambrian Life

Recent Publications **33**

A Country Craft *David L. Newlands* **34**
The Potteries of Grey County

For the Pleasure of Princes *K. Corey Keeble* **40**
Early Meissen Porcelain

Cover: East church of the Monastery of Alahan, interior of tower with squinch arches. Photograph Michael Gough.

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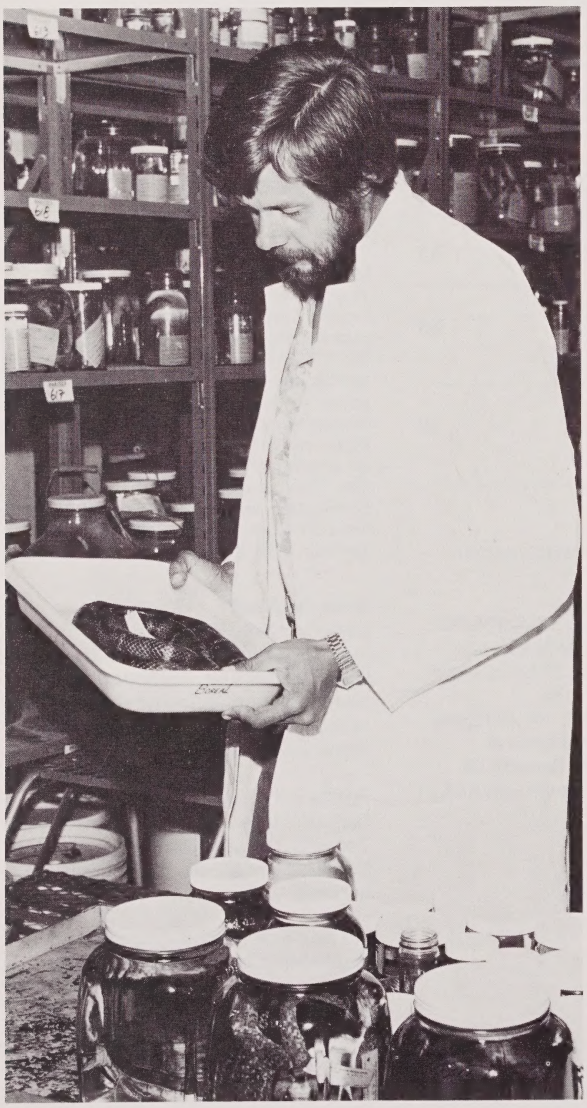
On Cooperative Studies in Belize

Jim Lovisek



IN EARLY FEBRUARY of this year I joined Dr. David Pendergast of the ROM at his archaeological field station at Lamanai in Belize. Now, whenever I mention Belize a puzzled expression invariably appears on the face of the person with whom I am speaking.

Belize, formerly British Honduras, is a tiny country nestled in the southeastern part of the Yucatán Peninsula and bordered by Mexico on the north and Guatemala on the south and west. Although only 174 miles long and 68 miles wide, the country has significant Maya ruins, the world's second largest barrier reef, and a fascinating diversity of flora and fauna.

My trip came about as a result of discussions between Dr. E. J. Crossman of Ichthyology and Herpetology and Dr. D. M. Pendergast of New World Archaeology. The two curators had talked about the possibility and potential benefits of interdepartmental cooperation on the Lamanai project, a large Maya site in the Orange Walk District of Belize. At Lamanai large numbers of bones were being excavated in the kitchen middens, and Dr. Pendergast was interested in the identity of the animals represented by these remains. Identification of such bones requires a reference collection of skeletons of present-day local animals to which the remains can be compared.

My objective in February was to collect specimens of fishes, amphibians, and reptiles—in fact, to begin assembling a reference collection, an undertaking from which both departments would benefit. Any new knowledge we could acquire of the food habits of the ancient Lamanai Mayas would enhance analysis of the archaeological evidence. Moreover, some insight into the environmental conditions that prevailed while Lamanai was a viable community might be extrapolated from knowledge of the community structure of the animals utilized by the people. At the same time the reference collection of the Department of Ichthyology and Herpetology would be enriched with specimens of a fauna now poorly represented.

Unlike Altun Ha, the archaeological site in Belize previously studied by Dr. Pendergast, Lamanai is relatively isolated, and access to it is limited to floatplane and boat. It seemed to me that because of this isolation no significant collections of fishes, amphibians, and reptiles would have been made, and I was understandably excited at the prospect of studying the fauna.

Many people have asked me how I collect amphibians and reptiles—questions that are difficult to answer, especially since the work covers such diverse groups as frogs, toads, salamanders, turtles,

snakes, lizards, and crocodilians. Even within each group different techniques are used for different species. Many snakes, lizards, and frogs can be located by searching areas of cover. At Lamanai, looking under rocks, in rotten logs, and beneath piles of fallen cohune palm fronds proved most rewarding, although wherever there are poisonous snakes the searcher must be very careful about where he puts his hands.

The Mayas who work at the excavations at Lamanai are terrified of snakes and firmly believe that most kinds are deadly poisonous. For example, they are convinced that the boa constrictor, a completely non-poisonous snake, has the intriguing ability to change into a poisonous serpent between midnight and dawn.

What really astonished me was the fear engendered in the Mayas by a small lizard, *Coleonyx elegans*, which belongs to the gecko family. The first specimen I saw at Lamanai was dangling limply by its neck from a two-foot piece of twine, very solemnly held at arm's length by the lizard's captor, one of the dig workers named Florentin. When I nonchalantly picked up the gecko and untied the noose, Florentin was effusive in his warnings about the poisonous properties of the tail and jaws, although, as is true of almost all lizards, the gecko is completely harmless.

During my four weeks at Lamanai, I managed to observe only six snakes, although I searched diligently both in the daytime and at night. Nonetheless, several new distributional records of reptiles were documented for Belize.

Fortunately, the overall collecting was more productive. Fishes were abundant in the New River lagoon and I was able to collect a large sample by setting gill nets. In all, the trip yielded 720 specimens, including 632 fishes, 21 amphibians, and 67 reptiles, representing 23 families, many of them new in the ROM collections. Moreover, the trip provided an opportunity to study a new fauna and to make a start on an ongoing, mutually beneficial, cooperative effort involving two ROM departments.

Jim Lovisek is associated with the Department of Ichthyology and Herpetology of the ROM.

Opposite page: Jim Lovisek sorting specimens from Lamanai. He is holding a tropical kingsnake.

Left: Bufo valliceps, *one of only two toad species found at Lamanai.*

They Carved the Stone

The Monastery of Alahan

Mary Gough

THE MONASTERY OF ALAHAN, excavated by the late Michael Gough, is in southern Turkey, some 70 kilometres south of Karaman (the ancient Laranda) and 23 kilometres north of Mut (Claudiopolis). Karaman lies on the edge of the plain of Konya (Iconium), which is ringed to the south by what appears to be a low range of hills. The traveller, however, as he crosses these hills from the north, finds himself in a high pass and realizes that the "hills" are really the tops of the Taurus mountains, which drop sharply away to the sea, over 100 kilometres away and about 1,600 metres below. Today's road follows fairly closely the line of the ancient one, although modern engineering has enabled it to take a more direct line on a high level. From the modern road the old highway can still be seen, zigzagging laboriously up and down the steep sides of the valleys. Both roads, old and new, meet at a hamlet, once a sizeable Roman *mansio* and now a local forestry post, from where a rough track strikes up the mountain again to the left. After about a kilometre over the ground and 300 metres vertically, the monastery is reached.

Alahan monastery lies on a narrow ledge on the mountain side, 250 metres in length and about 30 metres wide, part natural and part quarried and roughly orientated. On the north side of the ledge rises a low and almost sheer cliff; to the south the ground falls steeply away and the ledge is

Alahan—looking west along the ledge from the necropolis area, with the baptistry in the foreground, the east end of the basilica, and the cave complex.

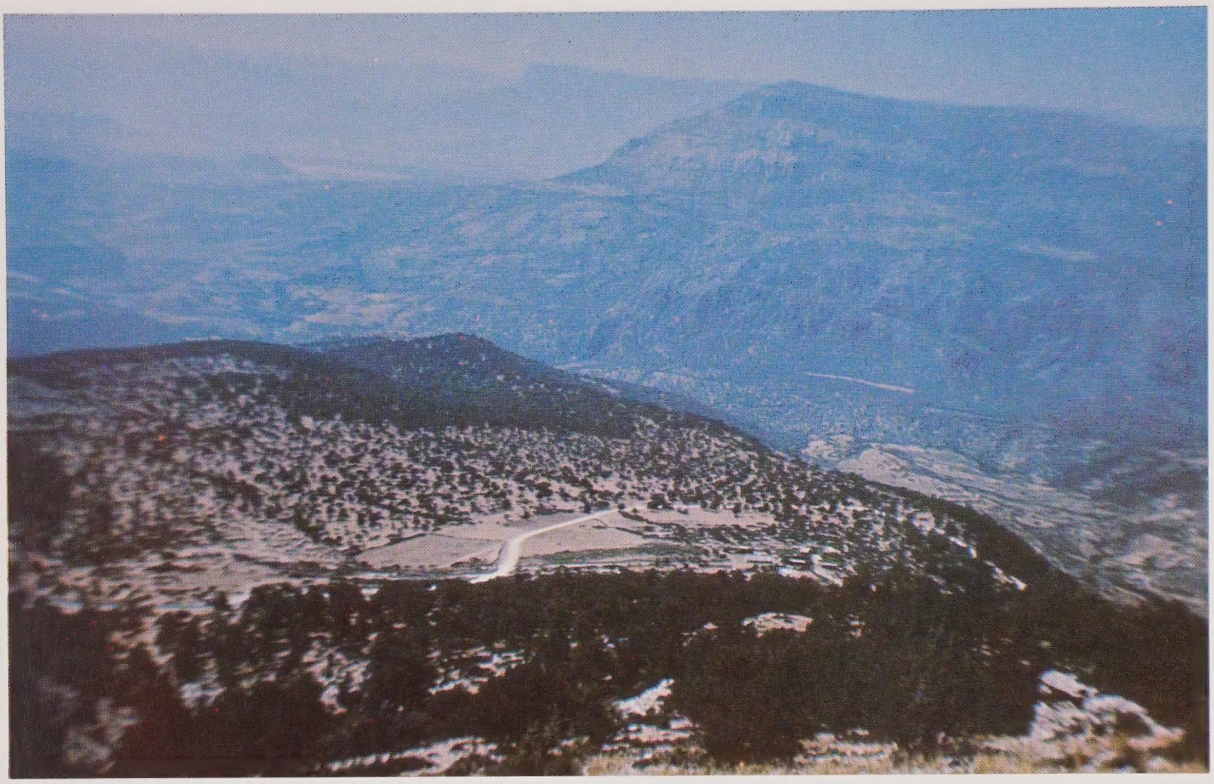
built up and confined by a retaining wall to give a relatively flat surface. The ledge itself rises gently from west to east and almost the whole of the monastery is within this area. Here are four churches (of which one remains only in vestigial form), a baptistry, a hospice, living and domestic quarters for the resident monks, and a necropolis area. The place conforms very well to the words of S. Basil, father of coenobitic monasticism, who wrote that a monastery should, ideally, be remote, peaceful, and beautiful. The views from it over the wild mountain countryside are superb, and the site was ingeniously chosen to be sheltered from the devastating north winds that funnel down the valleys in this part of the Taurus.

There were monastic communities before S. Basil's day but they were rare, most holy men preferring to retire altogether from the world as hermits. While admiring the hermits for their asceticism, Basil thought that the Christian virtues could be more readily practised in communities. In A.D. 370, shortly after promulgating these ideas, Basil became Bishop of Caesarea in Cappadocia. Isauria, the province in which Alahan is situated, was attached to the Patriarchate of Antioch but it has a common frontier with Cappadocia and, geographically, is no further from Caesarea than from Antioch itself; in climate and atmosphere it is much closer. Though we have no proof, it is tempting to think that the establishment of a small community of cave-dwelling monks at Alahan could have been directly inspired by Basil's words and could have taken place as early as the beginning of the 5th century.

What is harder to understand is how this primitive community became, less than 100 years later, the magnificent sophisticated monastery of which we have the remains today. The problem becomes simpler when we note that Alahan was not the only great religious foundation in the area that can be dated to that period; there are at least three others, and a host of smaller ones. It is thought that this sudden increase in ecclesiastical building was directly attributable to the Emperor Zeno (474–491), himself an Isaurian. Zeno no doubt wished to embellish his home province, but he had also inherited the grave theological (and thus political) dispute that divided Orthodox Christians from Monophysites. Monophysitism had been condemned by the Council of Chalcedon in 451, but it was by no means dead, and all Christendom was divided on the issue. Hoping to conciliate both sides, Zeno published in 482 his *Henotikon*, a compromise document which, like most compromises, failed to satisfy either. It is thought, though, that his grandiose building programme in Isauria may have been a sort of public rela-

Right: The Monastery of Alahan is in southern Turkey.

Opposite page: View from Alahan of the surrounding countryside and the hamlet below.



tions exercise coinciding with the *Henotikon* and designed to please Christians of both persuasions at least on a material level and at least in one province.

It has been frequently asked who were the monks of Alahan and who were the laymen who were baptised and who worshipped there. Michael Gough believed that they were probably the ancestors of the present population, though the district was more thickly populated then, as can be seen from the traces of the ancient olive groves, vine terraces, and field systems. He thought that, in the inaccessible mountains and valleys of the Taurus, conquerors and governments could come and go, faith and language could change, but that the same people were always there. Christian and Greek-speaking in the 5th century, Moslem and Turkish-speaking today. In support of this theory he would recall the fame of the Isaurian stonemasons and builders, who not only built superbly in Isauria itself but also travelled far, in companies, to work on important buildings elsewhere. Today's Isaurians display an innate understanding and feeling for working and building in stone and often, even in their own houses, employ styles and techniques that could well have been handed down from their remote forefathers.

The earliest part of the monastery is at the extreme west end of the ledge. Here a spur of rock curves outward from the cliff, and the limestone is honeycombed with caves. On an upper level small caves have been developed into living quarters, and at ground level one big cave is large enough to have had three separate storeys built inside it and to contain two churches, one barely traceable today, and a large chamber that may have been the first communal refectory.

This cave complex was the home of the first monastic community at Alahan but it soon became insufficient for their needs. It is suggested that the monastery became a place of pilgrimage, and that since the cave churches were not large enough to accommodate all the visitors, the monks found their privacy eroded. Whatever their problems, they tried to solve them by building a large basilica just east of the cave complex.

The basilica is 36 metres long and 15.5 metres wide; it has three aisles, the central aisle terminating in an internal apse, the north and south aisles in small rooms for the use of the officiating clergy and for storage of the Eucharist. The north aisle has a masonry facing abutting directly onto the cliff. At the west end the space in front of the cave complex was paved, forming a wide forecourt, and from it the basilica was entered directly through a narthex.

Although simple in plan, the basilica must have presented a far from simple appearance, owing to the glory of its architectural sculpture. The narthex no longer stands but can be reconstructed. It

Above: View east from the cave complex, showing the basilica with Evangelist door in the foreground and the east church at the far end of the ledge.

Right: Baptistry—the font from the east.

Left: Bath and well house from the south.

Below: Tetramorph beneath the lintel over the Evangelist door of the basilica.

must have given an impression of lightness and richness combined, with a triple entrance to the west and its southern end open and arched, the whole unified by elaborate and delicate mouldings and entablature. It would have been a fitting lead-in to the basilica and in particular to its important west door. This door is remarkable both on account of the interest and excellence of its carved decoration and because, even when the rest of the building was almost entirely buried, it stood alone, little affected by wind, weather, or human depredation. The doorway consists of a simple rectangular opening. On the outside the jambs are enriched with vertical mouldings, while the lintel carries in the centre a disc surrounding the head of Christ, supported on each side by flying angels. At the extreme ends of the lintel and halfway down the jambs are four busts, probably of the four Evangelists. On the inside of each jamb, facing each other, are two figures of archangels, Michael to the south and Gabriel to the north.

The underside of the lintel is particularly interesting, as here we have representations of the Evangelists in the form of the Beasts of the Apocalypse, united as a tetramorph. This is possibly the earliest representation of the Evangelist Beasts in this form, predating the one in the Rabula Gospels by some 100 years.

The interior of the basilica is divided into its three aisles by arcades of columns; above was a second register of columns on a string course and above again an orthodox clerestory. The three aisles have the same floor level, which is paved, but there is evidence of the use of small marble slabs arranged in geometric patterns and floor mosaic at the east end. A quantity of fallen glass and stone tessarae suggests that the interior of the apse was decorated with wall mosaics.

Shortly after, or even before, the completion of the basilica, further expansion at Alahan was found to be necessary and even more ambitious projects were undertaken. Almost simultaneously, it is thought, work on the east church, the baptistry, and the hospice was put in hand and the colonnaded walkway was at least conceived. As to the dates of these expansions and indeed of the monastery itself, we are fortunate in having evidence from two grave inscriptions. The first, which was not completed, records a "Tarasis, son of Tarasis, Priest and Custodian" who lived at Alahan from A.D. 461 but the date of whose death is left blank. The second is more explicit: "Here lies

Right: West façade of the east church during excavation of the narthex.

Below: View from top of north cliff above the baptistry, showing remains of the colonnaded walkway and shrine and part of the west façade of the east church.

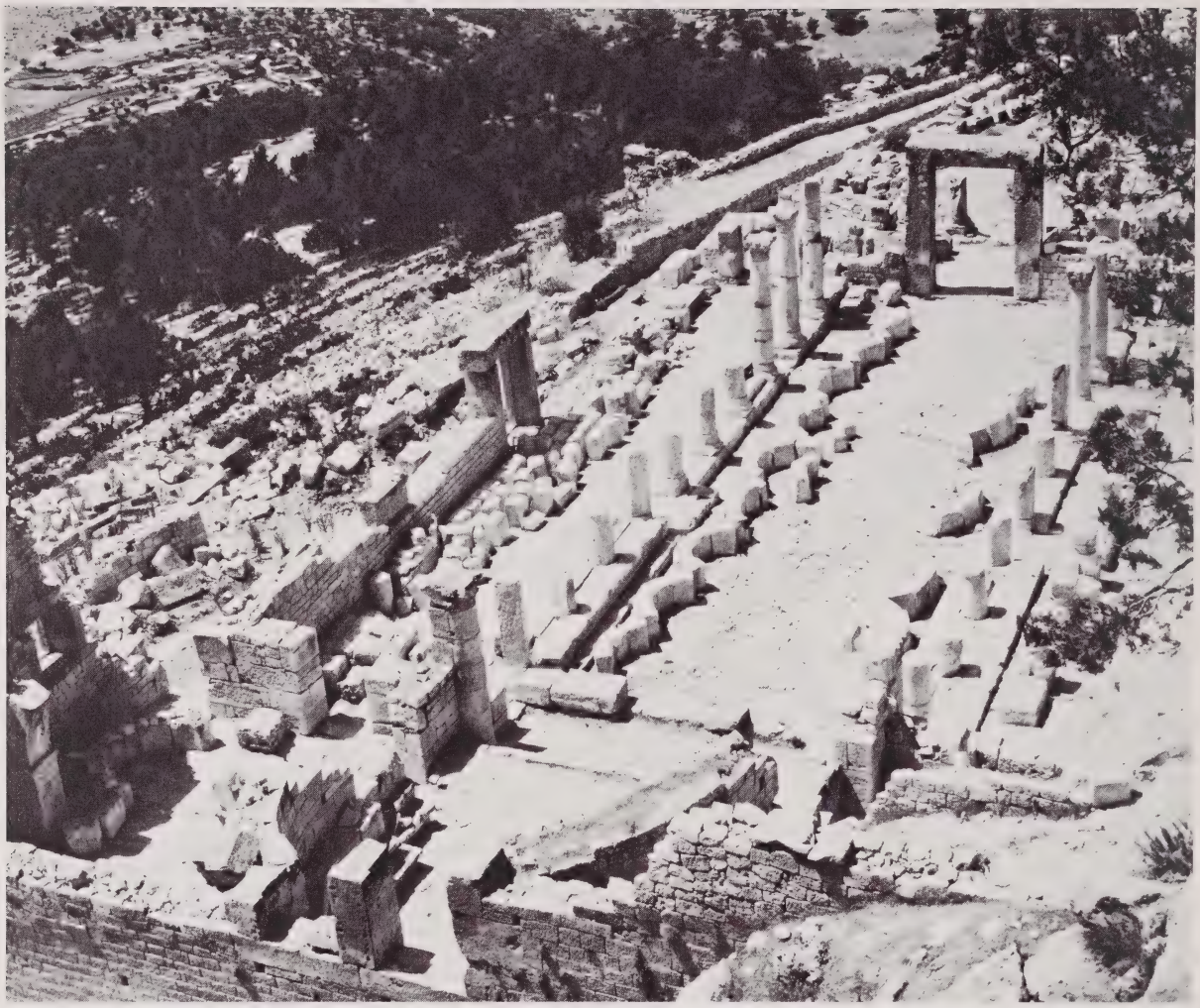
Detail of mouldings on Evangelist door of the basilica.

Tarasis of blessed memory, the Founder of the Hospice, who died ...(in A.D. 462)...on Tuesday of the first week in Lent." It is possible that Tarasis the Custodian was the son of Tarasis the Founder of the Hospice. Although these epitaphs do not pinpoint the date of the buildings themselves, the necessity for a hospice and a custodian suggests the existence at Alahan in the mid-5th century of a sizeable settlement with permanent buildings.

The hospice takes up most of the space between the basilica and the baptistry. It is a narrow building, which originally had two storeys. The ground floor, all that remains today, was devoted to the storage of wine, oil, and grain and contains also a kitchen and a bakery; a large chamber at the west end may have been a refectory. Living and sleeping rooms were probably on the upper floor. The hospice is a functional building and shows little sign of decoration, although some fragments of painted plaster were found in the rubble during excavation.

Next, passing from west to east, comes the baptistry, twin-aisled with internal apses, and approached from the south through a narthex. The font is midway between the chancel of the north aisle and the west end; it is cruciform and is sunk into the floor, the arms of the cross measuring approximately 1.5 metres in each direction. Three steps lead down on each arm of the cross to the plaster-lined base at the intersection. From the cliff to the north (the baptistry, like the other churches, is built directly against the cliff) a narrow conduit carried a continuous stream of water, which was drained through a hole in the base of the font. There was no problem in getting a more than adequate water supply to flow into the baptistry, as Alahan is very well supplied in this respect. Water from several perennially flowing springs was led by channels, rock-cut or dug and lined with stones, to all parts of the monastery, including the cells and dwelling places of the monks.

At the extreme end of the Alahan ledge is the east church, formerly known as Koja Kalesi (the great castle), which, for all its 1,500 years of existence, still stands almost to roof height. On entering it the visitor feels that only a little reconstruction would be needed to restore it to its original state. It is basically a long, aisled basilica, but the plan is complicated by a tower, with squinch arches at the angles, rising above the area immediately to the west of the chancel. This tower and the existence of the squinches have been the subject of much scholarly argument, many experts contending that the tower must have been crowned by a masonry dome. Michael Gough decided that the real answer was that although the architects were aware of the techniques for setting a round dome on a square bay, they did not actually do so here. He wrote: "The walls of the tower and the cross-bracing seem inadequate to withstand the downward and outward thrust of a heavy mass of masonry and the same may be said of the squinch arches and their supporting colonnettes;...no stones suitable for a dome have been found during the clearance of the nave below the tower. Rather than being domed, the tower may have been capped by a pyramid of timber which would have exerted little thrust and, once fallen, would have left no trace after the lapse of centuries." The church was entered through a narthex from the west from which three



Basilica from northeast and above.

doors led into the aisles. With the exception of the southwest door, the sculptural decoration of these and of the internal capitals is less rich than that of the basilica and a good deal more rigid, showing extensive use of the drill. Above the narthex was an entrance on a high level on the cliff leading to galleries over the side aisles.

Immediately west of a forecourt in front of the east church are domestic quarters, including a refectory, bakery, and kitchen, probably replacing the original ones in the cave complex. Cells and living rooms in the caves, however, may well have remained in use although further ones were cut into the cliff above the hospice and baptistry. The necropolis area, with the two notable Tarasis tombs, lies between these latter domestic quarters and the baptistry.

Simultaneously with the building of the hospice, baptistry, and east church, it must have been decided to unify the whole monastery by building a colonnaded walkway along the top of the retaining wall. This project was never completed, although plinths, bases, and some shafts still exist and have been re-erected. Incorporated into the colonnade is a shrine opposite the grave of Tarasis the Custodian; perhaps he was the holy man who made the monastery a place of pilgrimage.

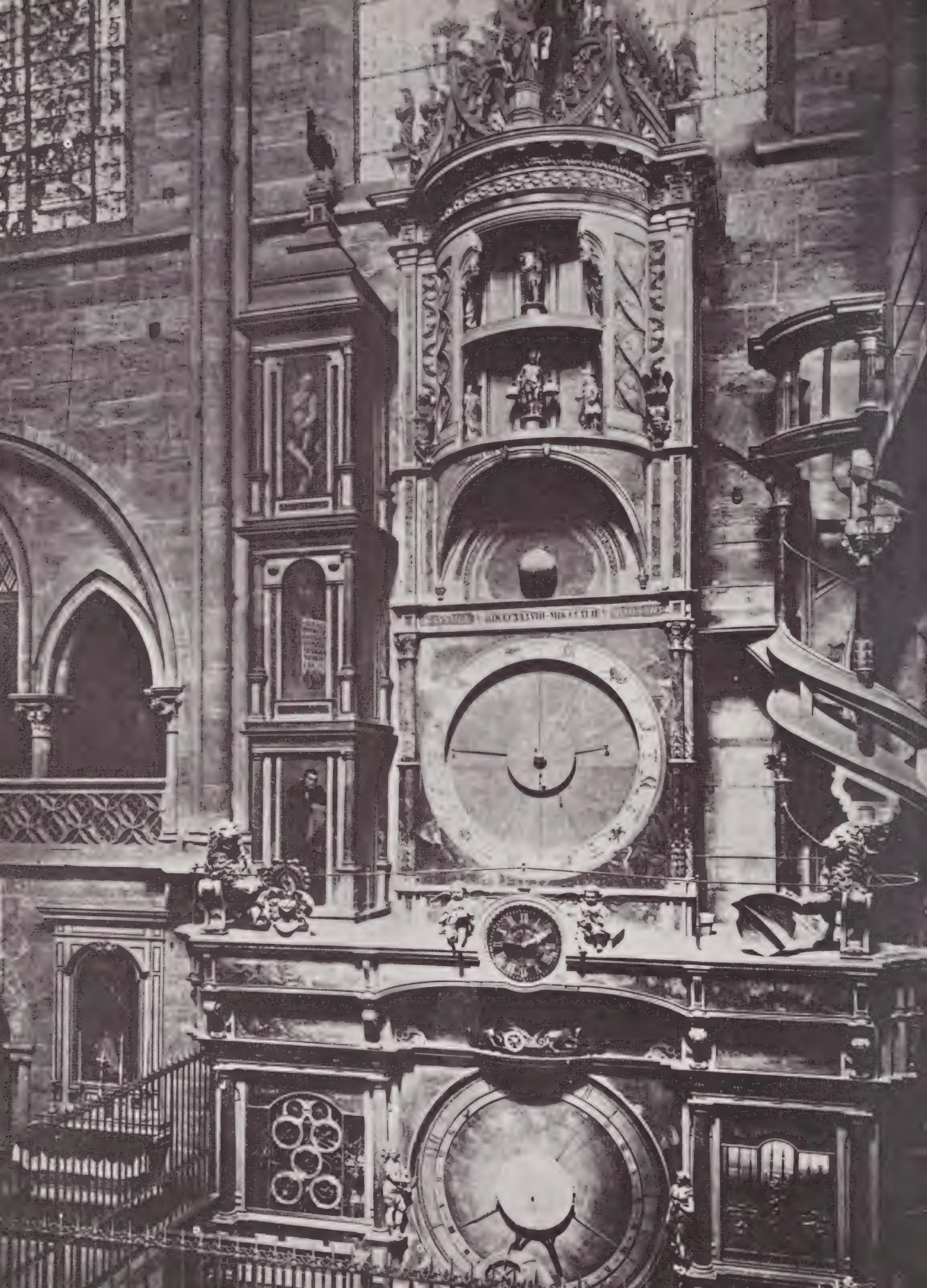
One further feature of Alahan

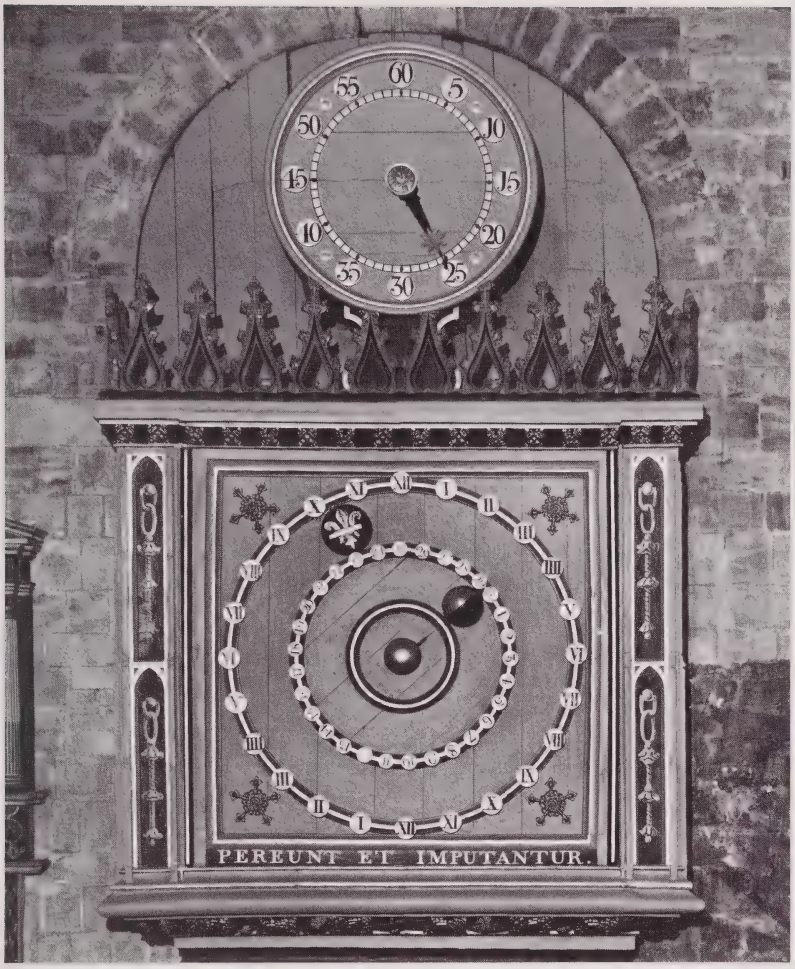
Detail of dolphin corbel supporting narthex beam in the basilica.

must be described—the bath and well house. It is situated east of the east church, up the mountain, and is serviced by one of Alahan's more important springs. A natural cave was developed and built up to form on the one side a very small one-person bath, complete with tiny furnace, hypocaust, and hot-water tank. The further side of the cave, separated from the bath by natural rock, has a masonry cistern in its inner recesses fed from the same spring. It is presumed that this area was used as a cool-room or larder for perishable foodstuffs.

We have no firm dating for the abandonment of the monastery, which is thought to have taken place in the 7th century. It may have been due to a natural disaster, such as an earthquake, but the fact that the east church has remained almost intact and the total absence of significant small finds other than pottery make it more likely that there was an orderly withdrawal from the site in the face of the Arab invasions of the period. The place was left derelict for some 500 years, but there is evidence that it was again occupied in the 12th and 13th centuries on a very modest scale. Today it remains a monument to the skill and the artistry as well as to the piety of its first builders. As the famous Turkish traveller of the 17th century, Evliya Çelebi, wrote, after seeing Alahan: "It was given to the people of that time to enchant the rocks so that they carved the stone... so fine that a man stands stupefied in amazement at the sight of them. This is something that deserves a visit."

Mary Gough is a naval architect by profession and a Research Associate of both the ROM *and the Pontifical Institute of Mediaeval Studies at the University of Toronto. She accompanied her late husband, Michael Gough, on all his archaeological expeditions and excavations. Mrs. Gough now lives in England, where she is at present editing the definitive work on Alahan (started by Michael Gough and now being written by several specially qualified scholars). Her own books include* The Plain and the Rough Places, *the story of the Goughs' early work and life in Turkey, and* A Turkish Village, *a booklet for children published by the Oxford University Press.*





Left: Astronomical clock of the Cathedral Church of St. Peter, Exeter.

Opposite page: Jean Schwilgué's astronomical clock in Strasbourg Cathedral, completed in 1842.

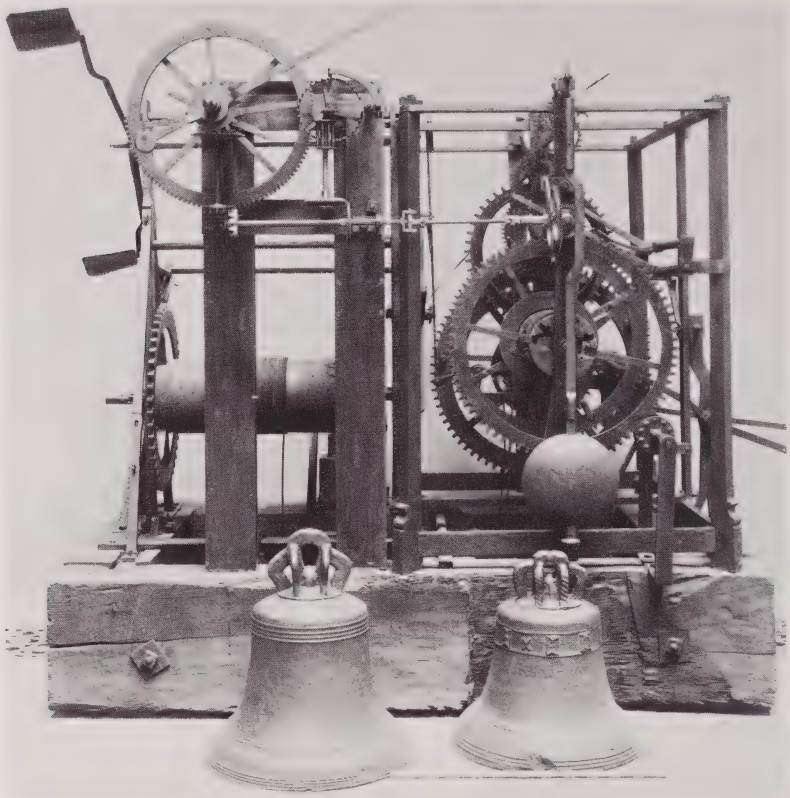
Time in Hours, Days, Years...

Cathedral Clocks

Henry C. King

SEVERAL CATHEDRALS in western Europe contain a large mechanical clock, which at the time of its design and installation represented a peak of achievement in horological science and art. Most of these clocks, if not all of them, now have modern movements, but their dial displays, with a few notable exceptions, still retain original features. The earliest examples take us back to the close of the 14th century, when the mechanical clock had been in existence for about 150 years, and the latest belong to the last few decades of the present century.

Medieval monumental clocks, with their impressive dials, bell-striking jacks, and arrays of moving statuettes, owed much of their popularity to the age-old fascination of large mechanical devices. Their dials reproduced the motions of the sun and moon, showed the phases of the moon and the positions of the moon's nodes, and indicated important events in the Christian calendar. The bells, sounded at the hours, and sometimes also at the quarters, provided a communal but extremely local time service. The automatons enacted Biblical and other scenes to



Mechanism of the ancient astronomical clock of Wells Cathedral. The pendulum conversion and quarter-striking arrangement are relatively late additions.

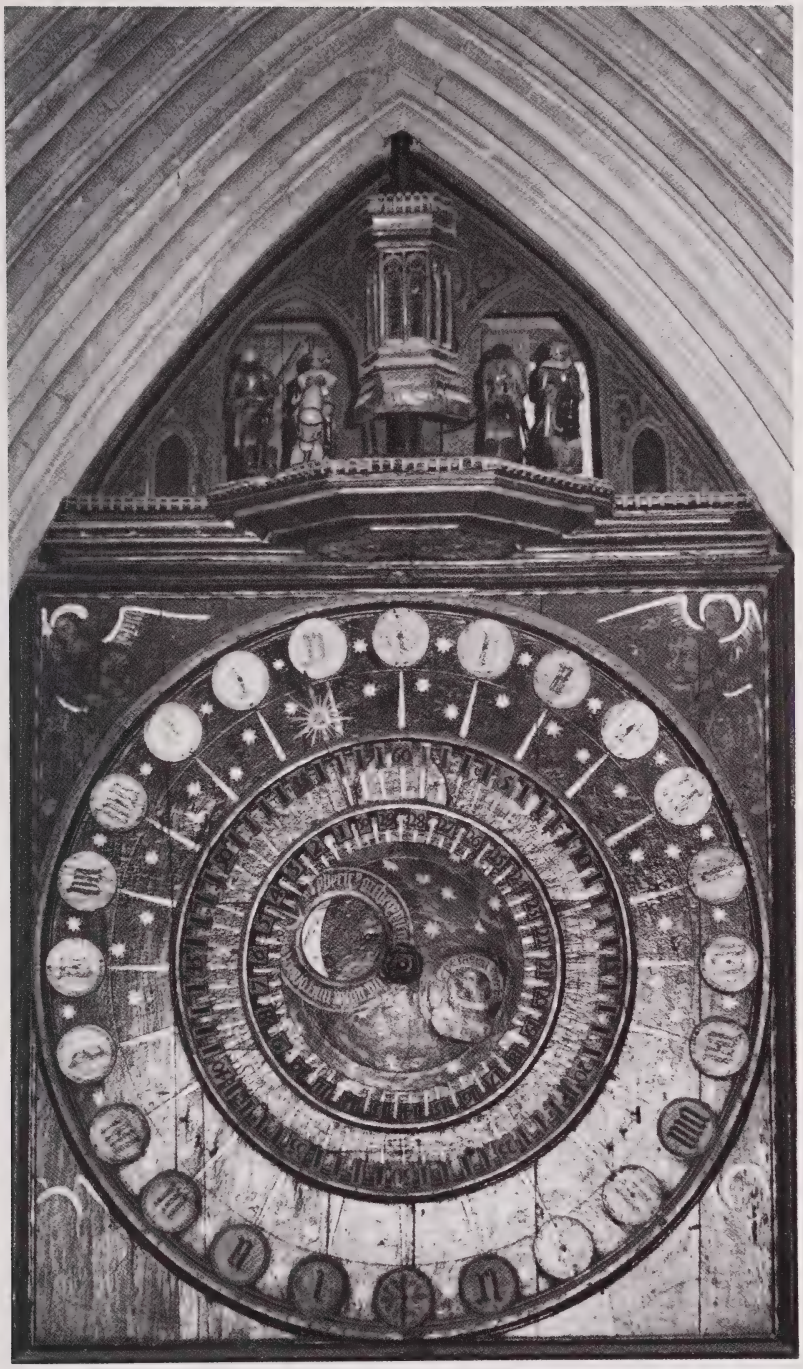
remind onlookers that their universe was at once physical, moral, and spiritual. In short, these clocks were not only triumphs of artifice but cosmic symbols — reminders that God in his munificence had set lights in the heavens to give signs for years, seasons, months, and days, and involved man in part of the perfect order and regularity of the *ouranos*, or supra-lunar realm.

The first cathedral monumental clock of which we have positive information was installed in the cathedral priory at Norwich. Cathedral records for 1322, 1323, and 1325 refer to expenses incurred in the construction of mechanical puppets and a large, mobile dial. Reference is made to gilded copper sun and moon plates, and also to numerous painted "images", which represented the hours of daytime and night and the days of the month. The clock is said to have stood in the south transept of the cathedral and to have been destroyed by fire in the 17th century.

Recent studies by J.G. North of Oxford have thrown considerable light on a large astronomical clock designed by Richard of Wallingford, abbot of the Benedictine monastery of St. Albans from 1326 until his death in 1336. The main display, erected in the south transept of the church, was similar to that of an anaphoric water clock: a circular planisphere depicting stars and the zodiac, rotated once in a mean sidereal day behind a fixed grid or rete of hours. Associated with the planisphere were sun and moon images and pointers for the positions of the moon's nodes (important in determining eclipses of the sun and moon). A manuscript describing the clock gives tables for calculating the gear ratios, illustrations of the gear trains, and details of an arrangement in which a rotating moon-phase ball was automatically drawn under an obscuring disc at the time of a lunar eclipse. Richard's untimely death (apparently from leprosy contracted in France) stopped all further work, and the upper dial of 24 hours and a wheel of fortune (a rotating pictorial plate representing the rise and fall of temporal power) were not completed until some 50 years later.

Because of the high cost in labour and materials of an astronomical clock, most ecclesiastics opted for a simple bell-ringing clock *sans* dial. An early and well-known example is exhibited in Salisbury Cathedral. Cathedral records show that it was made in or before 1386 and housed originally in a bell tower in the cathedral close. They also show that in 1790, when the bell tower was demolished, the clock was moved to the first stage of the central tower of the cathedral, where it remained until 1884.

To a discerning visitor, this old clock has much to say about early



Dial and automatons of the astronomical clock at Wells Cathedral.

craftsmanship, technology, and timekeeping, but, like all other clocks, virtually nothing about time itself. Part of the message is contained in the curious "six-poster" frame of forged iron, just over a metre high and nearly a metre and a half along its front. The frame members are fastened together not by screws but by mortises, tenons, and cotters, and various bars and struts are wedged into position to give extra rigidity. The latter also provide supports for the spindles or arbors of the large, toothed wheels, "lantern" pinions, and two wooden barrels that carry the drive-weights. Every part is hand-made, even the square-shaped gear teeth, formed by filing. Compared with most other extant turret clocks of the period, the design is primitive and the construction flimsy. Even so, the clock struck the hours for 498 years, must have ticked more than 500 million times, and is believed to be the earliest extant representative of its class in England.

The Salisbury clock was a distinct improvement on the earlier alarm clock, used in monasteries to alert a sacristan who then tolled the main bell. By its autonomous sounding of a bell every hour on the hour, it relieved the sacristan of an irksome duty and provided a local time service for all those within earshot. Ralph Erghum, the worthy bishop who had the clock made, could regularize non-secular activities, and people in commerce and business could tighten the relationship between time and money. Other citizens learned to eat not when they felt hungry, and to end their night's rest not when they felt refreshed, but when the cathedral bell dispensed the appropriate time signal. By paying homage to the clock they subscribed to a pattern of arbitrary time measurement, which eventually became extended across society.

The Salisbury clock-movement, like that of other turret clocks (and also of monumental astronomical clocks), consists essentially of two

separate gear trains. One, headed by an escapement, controls the descent of the main drive-weight, and the other, also weight driven, actuates a strike hammer. Also included are an "air-brake" that slows down the descent of the strike-weight and a notched "locking plate" for ensuring that the hammer makes the requisite number of strokes. The present wrought-iron escapement is a clever reproduction of the original and highly popular verge and foliot control. In this, a horizontal weighted bar or foliot, mounted on top of a vertical spindle or verge, receives impulses from the teeth of the last wheel of the drive train and swings to and fro, with a period of oscillation dictated by its own inertia and the mass of the drive-weight. Unlike the pendulum, which has its own natural period of oscillation, the foliot is an extremely unreliable timekeeper, so much so that a clock of this type could acquire an error of about 30 minutes in a day. Hence the need to appoint a *custos horologii*, who among other duties regularly checked his charge against a sundial.

Since Bishop Erghum was transferred in 1388 to the see of Bath and Wells and remained there as bishop until 1400, he probably employed Salisbury craftsmen to make the famous astronomical clock at Wells Cathedral. The original Wells movement, a slightly more elaborate version of the one at Salisbury, was installed sometime before 1392. It is now in the Science Museum in London, where it continues to sound the hour and also the quarters. Unfortunately, the verge and foliot have long since been replaced by a pendulum and 'scape wheel, but the movement does at least keep reasonably good time.

The Wells movement served two dials, as does the present mechanism, installed in 1880 by the firm of Gillett and Bland. The original outside dial probably had a single hand and two series of 12 hours, but the present face has two hands and a single set of 12 hours. The inside dial, nearly two metres square, has been restored several times, but some parts are believed to be as old as the original clock movement. There is little doubt that the display, then as now, showed the hour and quarters, and the age and phase of the moon. The ring of minutes and its index, however, are additions made probably in the late 17th century, when the movement received its present pendulum control.

The Wells dial is designed to portray the geocentric or earth-centred system of the world, a system that remained popular, even among astronomers, until early in the 17th century. The hour index (in the form of a gilt sunburst) and the moon-phase aperture move uniformly round a model earth at the dial centre. An inscription round the moon-phase aperture reads, in translation: "This circular dial represents the universe in miniature." Similar but less elaborate and more recent displays are found on astronomical clocks in the Cathedral Church of St. Peter, Exeter; Wimborne Minster; and St. Mary's Church, Ottery St. Mary. The dial at Exeter is believed to be a copy of one installed in 1423, but the other two dials are probably early 17th century.

The lunar indications of this small group of English west-country clocks had practical value. In lieu of an almanac, they provided a guide to the epact and

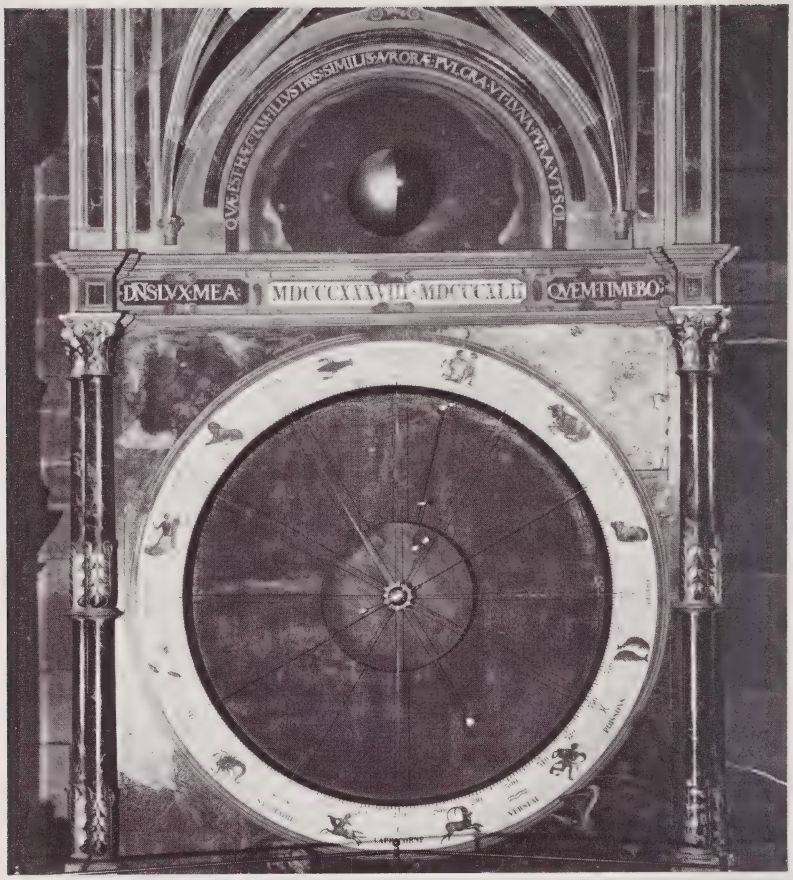
Astrolabe with planetary hands of the astronomical clock at Münster Cathedral.

Perpetual calendar and geared celestial globe of Schwilgué's astronomical clock in Strasbourg Cathedral.

date of the paschal full moon. They suggested the most suitable days for holding evening meetings in winter and undertaking journeys at night. In an age when the moon was generally believed to preside over animate nature, prior knowledge of its phase was important to farmer, fisherman, astrologer, alchemist, and physician alike. Finally, since the times of the ebb and flow of the sea at a given port depend largely on the moon's elongation from the sun, the indications could be used to obtain a rough idea of the state of the tide in a nearby harbour or estuary.

The automatons associated with the Wells clock are unusual in that they have no religious or philosophical meaning. As the clock strikes the hour, two pairs of model equestrian knights engage each other as if in a real tournament; one horseman (pivoted through his thighs) falls backward, only to be automatically restored. Higher still in the triforium, to the right of the knights, a seated wooden figure nicknamed "Jack Blandifer" strikes bells at the hours and quarters and also slightly turns his head. Automatons with the outside dial take the form of two knights in armour, each about 1.2 m high and carved from solid oak. At the quarters, each figure rotates slightly on a vertical spindle to strike a bell with his axe.

Many monumental astronomical clocks in central Europe have two large dials. The lower takes the form of a "perpetual" calendar, and the upper is a geared astrolabe with mobile sun and moon emblems. Early calendar dials were usually 1.5 m or more in overall diameter and worked on the principle of a plate or plates that rotated in relation to a fixed central disc. The general procedure was to mount a ring gear with 365 teeth on the back of a large plate. A pawl then engaged the gear at midnight and turned it through one tooth, the equivalent of an interval of one day. The plate carried radial divisions for the 12 months and 365 days of the year, together with the names of the days of saints and fixed religious feasts. In leap years it had to be delayed by one day on the night of February 28. In some instances, 366 teeth and 366 divisions were provided. Then it was necessary in non-leap years to advance the plate through two divisions on the night of February 28. Usually, a



Planetarium and rotating moon-phase globe of Schwilgué's astronomical clock in Strasbourg Cathedral.

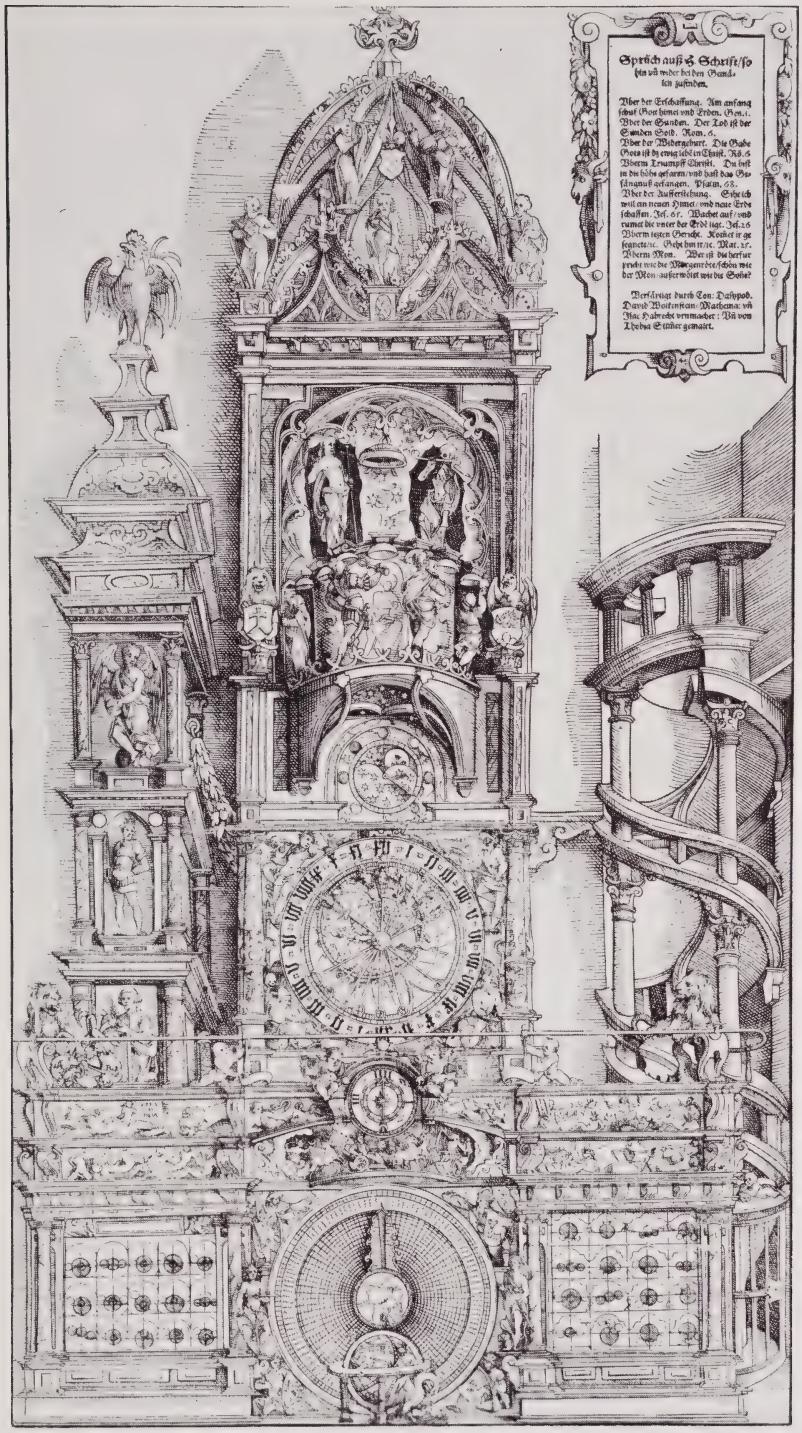
statuette, mounted on one side of the dial, directed a lance, sword, or wand to the current date.

In some calendar dials a small ring, and sometimes the fixed central disc itself, carried information about the solar cycle, golden number, dominical letter, and epact, and hence the dates of movable church festivals. This ecclesiastical computation was set out for a period of a century or more, after which time it had to be revised. Another feature, added to the central rotating plate of some dials, was a set of 12 circular medallions. Each medallion carried an allegorical painting of one of the months and was weighted so that the picture remained upright as the plate rotated. Finally, some calendar dials had a fixed surrounding zodiac ring. A sun emblem, mounted on the annual calendar at a place corresponding to the time of the vernal equinox, represented the position of the mean sun in the zodiac.

The most remarkable of all calendar dials is that of the present astronomical clock in Strasbourg Cathedral, the third of a series. Completed in 1842 by Jean B.-S. Schwilgué, it automatically takes care of the requirements of the Gregorian calendar and at midnight December 31 changes the dates of Easter and other movable feasts. This is made possible by a mechanical computer, which also gives readings on subsidiary dials of the year of the solar cycle, golden number, Roman indiction, dominical letter, and epact, and, by means of four jump-digits, the year of the Christian era up to and including 9999. Another mechanical computer controls the motions of four radial hands in the central part of the calendar dial. One hand, bearing a gilt sun image, indicates apparent solar time; one, with a small rotating moon-phase ball, gives the position of the moon relative to the apparent sun and local horizon; and two show the apparent times of sunrise and sunset.

Directly above this remarkable perpetual calendar is a Copernican planetarium, or mechanical model of the solar system. Images of planets out to Saturn are moved round a sun ball by radial arms at the approximate mean speeds of their natural counterparts. The largest of all cathedral planetariums is at Messina, where, along with a 4-m calendar dial, it can be seen by passers-by in the street below. It has a diameter of 5 m and carries additional arms and wheelwork for Uranus, Neptune, and Pluto.

The first Strasbourg clock, erected in 1354, probably had a large astrolabe dial. Similar dials



Second astronomical clock of Strasbourg Cathedral, after an engraving by Tobias Stimmer.

were an impressive feature of monumental clocks constructed between 1380 and 1598 for the cathedrals of Lund, Doberan, Stralsund, Frankfurt-am-Main, Villingen, Wismar, Lübeck, Münster, Strasbourg (1574, second clock), and Lyon. When we consider that an astrolabe dial bears no resemblance to the appearance of the night sky and is virtually incomprehensible to most people, its installation in cathedrals, churches, and town halls across central Europe is surprising. Perhaps the main reasons for its construction were ecclesiastical and civic pride and the traditional popularity of the astrolabe, at least among astronomers, mathematical practitioners, and the intelligentsia. There is no doubt that the possession of this type of mechanical marvel, regardless of its utilitarian value, conferred distinction on a town.

The second Strasbourg clock (1574–1838), a tower-like structure some 18 m high and 7.3 m wide at the base, rivalled the rest of the cathedral's interior in richness of colour, decoration, and religious symbolism. Surmounting the smaller of two towers was a gilded cockerel, symbol of vigilance and of Christ's Passion. Made of iron, copper, and wood, it flapped its wings, opened its beak and put out its tongue at noon, and, by means of bellows and a reed, crowed. Actually, it was all that remained of the first clock. It must have begun its antics about 1354 and continued in service until 1640, when it was struck by lightning and silenced forever. A similar cockerel is mounted on the present Strasbourg clock.

In the top compartment of the second clock, also at noon and to the sound of a carillon, statuettes of the three Magi bowed before a figure of the Virgin Mary and Christ Child. Lower down, just before each hour figures of Christ and Death enacted a pantomime that involved the striking of a bell, and lower still, statuettes representing the four "ages" of man

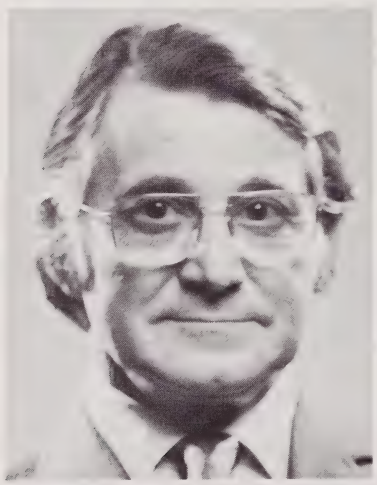
(infancy, youth, manhood, and old age) appeared in turn at each quarter-hour to strike one, three, five, and seven cymbals. Panels painted by Tobias Stimmer lent an eschatological note with scenes depicting the Creation, the Resurrection of the Dead, the Last Judgement, and the Rewards of Virtue and Vice. At the base, in front of the calendar dial, a mobile 86-cm celestial globe set for the latitude of Strasbourg was accompanied by the figure of a pelican, symbol of eternity.

Automatons perform similar functions on the third Strasbourg clock, but for highly imaginative scenes one must turn elsewhere, in particular to the cathedral clocks at Besançon, Beauvais, and Messina. The one at Beauvais, for example, installed in 1871 by Auguste Vérité, contains a tableau of 33 statuettes. At the clock's summit, a figure of Christ seated on a rainbow surmounts a cross flanked by the Virgin and St. Joseph. Lower down, turrets, towers, castellated walls, and dungeons represent the various levels of moral excellence to which humanity can rise or fall. Four figures appear in turn at the quarter-hours to remind onlookers of the four "ages" of man, and at certain daytime hours the clock actuates an animated scene of the Last Judgement. Heralded by a crowing cockerel, the hour strikes, St. Michel considers the balance scales of righteousness, and Christ gives the signal for the end of the world. Angels sound trumpets, and people at windows are replaced by flames. An angel then conducts Virtue to Christ, an action accompanied by a melody from a concealed 30-pipe organ. The melody over, Vice is judged and led away in chains by a hideous demon.

To anyone unfamiliar with horology, the indications given by an early monumental astronomical clock must have seemed almost miraculous. Man had made a machine that ostensibly reproduced nothing less than the motions of the sun and moon, and showed the hour of day, independently of the actual sun and sundial. The mystery was made all the greater by the concealment from vulgar gaze of the weight-drive and wheelwork. To some writers the clock was a fascinating reminder that the order and regularities found in the heavens extended inward to embrace man and his affairs. The function of its escapement was analogous to God's restraining influence on the rotating spheres of heaven, and the co-ordination of its parts imaged the relationship between man and the divine, or temporality and eternity.

Robert Boyle, the famous 17th-century chemist, thought that the second Strasbourg clock illustrated the so-called "clock analogy"— that the physical system of the world, created and set in motion by God, is like an immense clock. This notion, attributed to Nichole Oresme (d. 1382), was revived during Newton's age, when monarchal deism became intellectually fashionable and God became known as the "Great Mechanick", "Divine Artificer", and "Architect of Nature". It is, however, a highly misleading notion, if only because a clock is not a creation but a fabrication. Except for the co-ordinated motions of its wheels, it is an inert, passive thing. It cannot repair or adjust itself, or develop into something more complex and accurate. As to its future, it will wear itself out, and like the Strasbourg clock in 1780 eventually cease to function.

Boyle would have entertained second thoughts about the clock analogy had he been able to see the curious navigational dial of the memorial clock in York Minster, the Jens Olsen chronometrical masterpiece in the city hall in Copenhagen, and modern digital clocks and watches which subscribe to the temporal strictures of fast-paced industrial societies. These and other autonomous timers have little connection with the sun, still less with the moon, and none at all with the planets and stars. They certainly carry no symbolism of a divine order.



Henry C. King took his degree in astronomy and mathematics at the University of London, and later gained his M.Sc. and Ph.D. in the history and philosophy of science. He was appointed Curator of the McLaughlin Planetarium in 1966. Dr. King is author of several books, including The History of the Telescope, Exploration of the Universe, *and* Pictorial Guide to the Stars, *and is now preparing a new work,* Time, Clocks and Eternity. *His* Geared to the Stars, *a definitive text on the history of planetary machines and astronomical clocks, is in publication at the University of Toronto Press.*

The Growing Collections

Since the Chinese costume exhibition, "In the Presence of the Dragon Throne", which was held at the ROM last spring and summer, several important Chinese court coats have been donated to the collections.

The rarest is an emperor's tapestry-woven twelve-symbol coat (below), a gift of Mrs. Edgar J. Stone. Most of these special garments have imperial yellow fields, but this example with a blue ground must have been made to be worn during the period of fasting preceding the annual sacrifice at the Altar of Heaven, when blue was the prescribed colour. The coat dates from the reign of the Chia-ch'ing emperor (1796–1821). Twelve-symbol coats were worn only by emperors and can be dated with precision. They serve as standards for dating other garments on stylistic grounds.

The second coat dates from the end of the 19th century. It is a brocaded blue gauze court coat of the type worn by lesser nobles and high civil officials (left). It is of particular interest because its donor, Mrs. Vera Clark, can document its source to the province of Szechwan in western China.

A third coat of embroidered brown silk twill was made for the young son of a prince of the imperial clan. It dates from the second quarter of the 19th century and is the gift of Mrs. W. H. Baldwin. At the imperial court a man's rank determined the type and style of garments worn by his wife and children. J.E.V.

The collection of contemporary Woodland paintings in the Ethnology Department has been enhanced by the recent acquisition of a Johnston Meekis painting. Mr. Meekis is a young Cree artist from Red Lake, and has been painting since 1972. His work depicts traditional Cree legends through distinctive Woodland images and spirit lines. M.T.

The departments of Ornithology, Botany, and Mammalogy have recently received substantial collections from the estate of the late Hoyes Lloyd. Nearly 5,000 birds, 2,500 plants, and 150 mammals from his private collections in Ottawa were donated to the museum.

A graduate of the University of Toronto, Mr. Lloyd was a good friend of the Ornithology staff at the ROM over a period of many years. Well known as an ornithologist in his capacity as Superintendent of Wildlife Protection in the Department of Mines and Resources (forerunner of the present-day Canadian Wildlife Service), he was a member of many ornithological and bird preservation societies around the world, and served a term as president of the American Ornithologists Union.

Mr. Lloyd began collecting birds in Ontario in 1899 and continued to do so until a few years ago. Most of the birds were from Ontario, with substantial numbers from other parts of Canada, and the collection contributes a great deal to our knowledge of bird distribution in this country. A number of rare and extinct birds, including a Whooping Crane, a Passenger Pigeon, and several Peregrine Falcons and Trumpeter Swans —which Mr. Lloyd was able to acquire from other people— enhance the value of this collection. Three species now protected under the Endangered Species Act of Ontario are illustrated: Bald Eagle, Peregrine Falcon, and Piping Plover eggs.

The museum also received detailed journals covering a period of 71 years, which will be an invaluable record of the life and work of Mr. Lloyd and will provide details of the acquisition of the specimens in his collection. R.D.J.

As a result of the special exhibition "A Gather of Glass", October 7 to December 31, 1977, a number of fine pieces of glass were donated to the museum collection, most of them in the course of the Sunday Identification Clinics on October 16 and November 6. The gifts are fairly wide ranging.

Mr. Rudy Eswarin donated a small pitcher of blown olive glass, particularly interesting as it appears to be the same as one illustrated in McKearin's monumental *American Glass,* which is attributed to the Rockville Glass Manufactory, Steubenville, Ohio, c. 1836–1846.

When the exhibit was being organized the museum lacked any good examples of cut lead glass of the "Brilliant Period", the period about 1900 to 1920 when good quality lead glass with rich cutting was a preferred tableware. The Canadiana Collection has recently received a pitcher, berry bowl, and nappies, cut in a pattern patented by Roden Bros., Toronto, in 1910 (anonymous gift), and a large vase from Mrs. Sally Brenzel. Mr. Robert G. Paterson gave Canadiana a pair of finely cut salt-cellars with original silver spoons by the Roden firm, c. 1908, and a Gundy-Clapperton pitcher of the same date. A very fine cut-glass punch bowl with four cups and a pitcher were donated to the European Department by Mrs. Bruce King. These all seem to be by the Libbey firm of Toledo, Ohio, c. 1903.

Other glass pieces were received from Mrs. King, Miss B. Moad, Mrs. L. N. Millin, Mr. George M. McKanday, Miss Dorothy E. Lawrence, Mrs. Ethel M. Simmonds, and the Reverend and Mrs. A. Welburn Jones. The most contemporary example (1975) is a glass statue of a nude by the noted Czechoslovakian artist, Professor Miroslav Klinger, which was donated by Mr. J. Markovic. Although at present in a damaged state, it appears to be well worth restoring.

The most important addition is a tall commemorative goblet, wheel engraved with the profile and cypher of Catherine the Great of Russia (illustrated). This Germanic-style goblet is either Russian or Saxon and stylistically seems to date from early in the reign of Ekaterina Alekseyevna (1762–1796). Mr. John Schorscher presented the goblet and a mid-18th-century Silesian sweetmeat dish to the museum. The goblet complements recent acquisitions for our Russian collection: a dinner plate from a court service for Catherine the Great; a 1771 commemorative medal for Count Orlov, her lover; a late-19th-century officer's silver hat badge; and a fine early-19th-century metal box from Tula. C.P.K.

First Things First

Aspects of Precambrian Life

R. E. Barnett and D. M. Rudkin

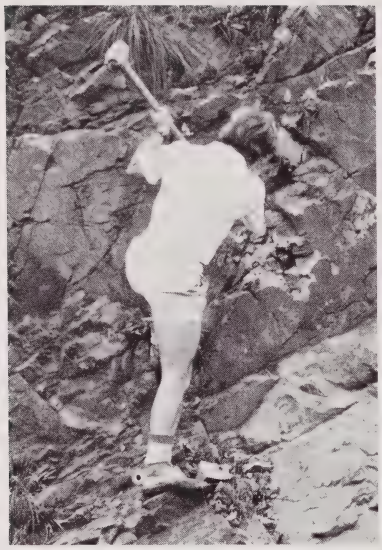
Left: Outcrop of red stromatolitic chert of the Gunflint Formation at Mink Mountain, west of Thunder Bay, Ontario.

Below: Dr. Andre Keyser and Dr. Nicolas Beukes in the Barberton Mountains, Eastern Transvaal, Republic of South Africa.

IT IS DIFFICULT to imagine the earth devoid of life, for today even in the most inhospitable of environments we can usually find some organism with the ability to survive and reproduce. But there is a period of about one billion years in the history of the earth for which there is no record of any living thing. It was during that time the processes that would eventually culminate in life began.

From chemical and physical analyses of earth and moon rocks, and from similar studies of meteorites, scientists have determined that our solar system formed some 4.6 billion (4,600,000,000) years ago. The sun and the planets with their respective satellites (including earth and its moon) apparently all had common beginnings in a vast cloud of dust and gas, which condensed and contracted under the influence of gravitational forces. The breakdown of radioactive elements in the early earth provided sufficient heat to melt and recombine other elements. Gradually, the new materials that formed separated into layers. Each layer, from the outer skin to the centre, virtually floated on the others, owing to differences in density of the substances of which the layers were composed.

The thin outer skin, or crust, is that portion of the earth with which we are most familiar, because the rocks comprising it are readily available for study. The underlying layer, the mantle, is rich in iron silicates. It is subdivided into an outer semi-molten band and an inner solid



part. The core also consists of two parts, an outer molten nickel-iron layer, and at the very centre of the earth a solid mass of iron. Our knowledge of the mantle and core is based almost solely on data from geophysical studies, since the materials themselves are buried too deep to be examined directly.

All available evidence indicates that the earth has maintained this overall structure since just after its formation 4.6 billion years ago. However, the face of the earth has undergone considerable change, and indeed is still undergoing it, as large pieces of the crust, carrying the continental masses, move about relative to each other. The edges of these rigid plates, floating on the underlying mantle, are constantly being created and destroyed. As a result, much of the rock that made up the crust of the primitive earth has long since been reabsorbed and recycled.

The oldest rocks left on earth are only 3.75 billion years old, and there remains, therefore, a gap of about one billion years in earth history for which we have no record at present. Unfortunately, it is within this time gap that the most important steps leading to the establishment of life on earth took place.

In order to facilitate the study of the earth and the physical, chemical, and biological processes that shape and modify it, geologists have established a time scale upon which significant events can be plotted. As methods of dating and correlating rocks have been refined, the almost incomprehensible amount of time involved has been divided into progressively shorter units. There is one division, however, that encompasses the greatest part of all geological time. It is the Precambrian Era, and it includes all the early history of the earth, from its formation 4.6 billion years ago to the start of the Phanerozoic Era, a mere 600 million years before present.

Traditionally the fossil record has been regarded as beginning at the base of the Phanerozoic Era, but we now realize that living things did not suddenly appear 600 million years ago. The apparent start of the fossil record at the base of the Phanerozoic Era can be attributed to the fact that organisms at that time developed the ability to construct mineralized skeletons for support and protection. Their chances for preservation were thus greatly improved. In fact, the fossil record begins almost 3 billion years earlier during the Early Precambrian, but the oldest organisms, because of their microscopic size, have until relatively recently been all but overlooked.

The processes that organized the lifeless chemicals of the earliest earth into living matter — first preserved in rocks 3.2 billion years old—are only sketchily known. Laboratory experiments initiated in 1953 have shown that amino acids, which are the chemical building blocks of proteins and hence of all living things, can be synthesized from inorganic chemicals. By the process of passing an electrical spark through a mixture of water vapour, ammonia, methane, and hydrogen, a series of amino acids and other organic molecules can be formed. These alone, however, do not constitute life, and a living organism has never been created in the laboratory. The atmosphere of the primitive earth is thought to have contained water vapour, ammonia, methane, and hydrogen; and heat from volcanic activity and electrical energy from lightning were available to drive the process. The combination and

Opposite page, left: Dr. Nicolas Beukes collecting Fig Tree cherts from an outcrop in the Barberton Mountains.

Opposite page, right: Robert Barnett examining an outcrop of the Gunflint Formation at Whitefish Falls, west of Thunder Bay.

Left: Cliffs formed of 1.9-billion-year-old stromatolites in the Pethei Formation, along the East Arm of Great Slave Lake, N. W. T.

recombination of inorganic compounds over a period of about one billion years would inevitably produce organic molecules, which could subsequently be organized into living matter. These complex early stages of chemical and organic evolution can only be guessed at, since the evidence for their occurrence would have been preserved in rocks predating the oldest ones still in existence.

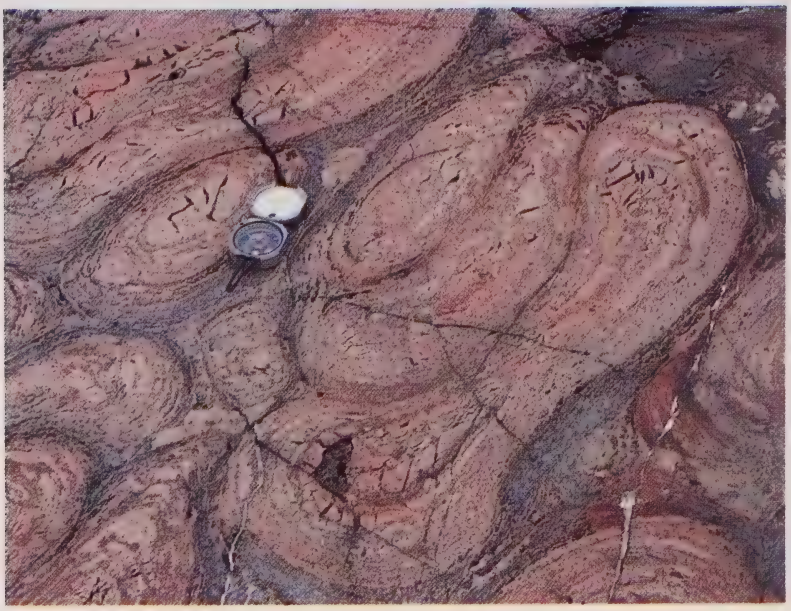
We can, however, speculate on the general progress of organic development. The earliest life probably could not produce its own food and had to survive by feeding on organic molecules in the water around it. Such an organism would continue to survive only as long as there was food within reach. It became essential for the earliest life forms to develop a method for manufacturing their own food out of the inorganic substances available to them. This need was met by the process of photosynthesis, and the organisms first able to utilize this method of feeding had made a significant advance. The presence in some of the oldest rocks of small amounts of free oxygen—the gaseous by-product of photosynthesis—supports this theory. The development of a photosynthetic organism meant that life had a much greater chance of success on the primitive earth.

Of all living organisms, the bacteria and blue-green algae are perhaps the most primitive. These two groups of organisms, alone among all others, lack a cell nucleus, and their genetic material is diffused throughout the cell. Their chances of passing on advantageous genetic traits are thus greatly diminished, and the rate of evolution among them is extremely slow. When we begin to look for the earliest forms of life on earth, it is these primitive blue-green algae and bacteria that we expect to find, and indeed do find.

In the eastern Transvaal, along the border between the Republic of South Africa and the Kingdom of Swaziland, lie the Barberton Mountains. These low-lying, rolling hills are in part composed of the Swaziland Sequence of sedimentary rocks, which includes outcrops of the Fig Tree Formation. This particular formation consists mainly of black, waxy cherts (tough, fine-grained rocks composed of silica), sometimes fractured by later metamorphism and recemented with quartz. It is in these rather unimpressive cherts that we find the remains of the oldest known life forms on earth—3.2 billion years old based on rubidium-strontium radiometric dating methods.

In 1967 Dr. Elso Barghoorn and Dr. Thomas Schopf described minute, rod-shaped, bacterium-like forms and spheroidal microstructures from these rocks. The minute, rod-shaped cells so resembled modern bacillar bacteria in size, shape, and cellular organization that these early forms were named *Eobacterium isolatum* ("dawn" bacterium); the spheroid forms, which closely resemble certain types of modern blue-green algae, were named *Archaeosphaeroides barbertonensis* ("ancient" spheres). The unicellular fossils exhibit a granular surface texture and commonly contain clumps of organic matter interpreted as protoplasm. The geochemistry of the sediments in which these organisms are found indicates that they were probably photosynthetic.

The Fig Tree material was initially studied at Harvard University by means of electron and light microscopy. *Eobacterium* can be



Natural section through stromatolite domes of the Pethei Formation.

seen only with the electron microscope, as it is a mere .5 to .7 microns long and .2 to .3 microns in diameter. The thickness of the two-layered cell wall is about .15 microns. These data agree with those for modern bacteria in terms of structure and size. *Archaeosphaeroides* can be observed under the light microscope, and the first measurements indicated a diameter of 17 to 20 microns. Since the initial description, more than 1,300 spheroids from the Fig Tree have been measured. The sizes range from 1 to 203 microns, but the average remains about 18 microns.

In 1974 one of the authors of this article, Robert Barnett, accompanied two South African geologists, Dr. Andre Keyser and Dr. Nicolas Beukes, into the Barberton Mountains to collect specimens of the Fig Tree cherts. Using maps and copies of Dr. Barghoorn's notes, the party located outcrops of the Fig Tree cherts in several fields and river cuts. The chert was extremely hard, and sledge hammers were required to enable us to get sufficient samples. Owing to the microscopic size of these organisms, the best we could do in the field was to collect as much chert as possible and hope that, somewhere in all that mass of rock, fossils would be found. At one locality on the Masubi River we discovered some Middle Stone Age implements, made of this same chert, and eventually we tracked the source of the material to an outcrop in the river bed. It seems a great irony that the rock we sought with such eagerness had been discovered and used for other purposes thousands of years before.

The earliest evidence for life visible to the naked eye is provided by stromatolites. The term stromatolite refers to any structure produced by the trapping, binding, or precipitating of sediment as a result of the growth and life functions of microorganisms. Physically, this structure usually takes the form of alternating layers of algae and adhering sediment. Stromatolites may also consist of alternating layers of photosynthetic bacteria and sediment. It is the trapped sediment that is usually preserved in the form of laminations or domes in the rock.

Modern stromatolites grow in just about any aqueous environment as long as there is sufficient light for photosynthesis. An adequate source of material for building up the accumulation is also necessary, whether in the form of loose sediment or of dissolved chemicals. Today stromatolites are much rarer than they were 2 billion years ago. Most occur in areas where few other organisms can survive, including hot springs and shallow marine embayments whose waters have an unusually high salinity.

Until recently the Bulawayan stromatolites of Southern Rhodesia (Zimbabwe), dated at 2.6 billion years old, were thought to be the oldest megascopic evidence of life. Late last year, however, fossil stromatolites were found in the Wit-Mfolozi River valley in Natal, Republic of South Africa, and these forms occur in rocks dated at 3 billion years old. This fact indicates that stromatolites began to develop very soon after the appearance of the organisms found in the Fig Tree Formation. The Wit-Mfolozi River stromatolites are preserved in partly silicified dolomite and appear as bumps about 1 to 2 cm in diameter and 1 cm high on the rock surface. These low domes are very reminiscent of growth forms found in recent blue-green algal communities.

To catch a glimpse of the remarkable diversity attained by single-celled organisms during the Precambrian Era, we need to look no farther than the Thunder Bay region of northwestern Ontario. Inland from Lake Superior and along its shores, from the town of Schreiber west to the Lakehead and south into Minnesota, there is exposed a series of sedimentary rocks named the Gunflint Formation, dated at 1.9 billion years. Within this formation occur beds and lenses of chert that in places show a knobby or hummocky surface. These structures have been interpreted as stromatolites. When the rock is cut or broken at right angles to the surface, distinct layers can be seen—they look like small inverted bowls stacked on top of one another. Even when the surface lacks the knobby texture, flat-lying layers can still be seen in section. While this may indicate the work of algae, the presence of these minute organisms can be confirmed only by preparation of thin sections of the rock. Microscopic examination of certain of the black cherts reveals an amazing variety of microfossils in a superb state of preservation.

Although a number of the Gunflint forms are not directly comparable to any living organism, others are strikingly similar to species of modern blue-green algae and bacteria. Basically, two groups of microfossils are present: individual, isolated forms and long threads or filaments. The individuals are of various shapes, including simple spheres, and range in diameter from 5 to more than 30 microns. The filaments include forms with and without cross partitions dividing them into cells, and attain lengths of more than 300 microns. Filamentous types dominate the assemblage and are most reminiscent of living forms.

The Gunflint algae and bacteria lived in a shallow, often turbulent sea, trapping and binding fine sediments into mats and stromatolites. The water levels

Above: One-ton, 1.4-billion-year-old stromatolite block from the Sibley Group, northeast of Thunder Bay, now on display at the ROM.

Above: Great Lakes Paper Company crew removing the one-ton block.

apparently fluctuated to such an extent that occasionally the algal structures were exposed above low tide mark and dried out, and then were resubmerged. There are two possible sources for the silica that is responsible for preservation of the Gunflint fossils. The more attractive theory holds that the silica was dissolved in the sea water in which the organisms lived and died. Alternatively, the silica may have been introduced by ground water after the death and burial of the organisms, but their fine preservation argues against this choice. Whatever the reason for their existence may be, the Gunflint fossils provide a unique and valuable insight into the diversity of Precambrian single-celled life.

A much different aspect of Precambrian life is preserved in a more remote region of Canada. Stretching for many kilometres around the East Arm of Great Slave Lake in the Northwest Territories is a group of sedimentary rocks named the Pethei Formation. Essentially the same age as the Gunflint Formation, these limestones and dolomites are in places composed entirely of stromatolites. They form cliffs tens of metres high and extend for hundreds of metres along the shoreline, attesting to the incredible ability of the Precambrian algae and bacteria to trap and bind sediments. The stromatolite forms include not only simple domes, but also complex branching structures and elongate mounds.

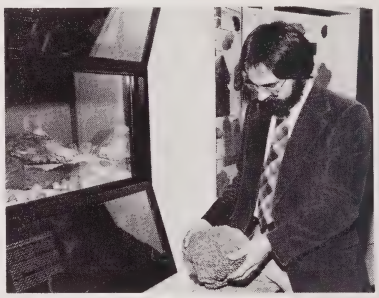
The environment in which the Pethei stromatolites grew was probably very similar to the shallow, turbulent Gunflint seas, with one notable difference: there was little or no silica dissolved in the waters. As a result, the organisms responsible for this impressive display have not been preserved. All that remains in the rocks are occasional thin, dark layers rich in organic compounds, which alternate with lighter layers of sediment.

Closer to home we find spectacular stromatolites occurring in rocks of the slightly younger Sibley Group (1.4 billion years old) around Disraeli Lake, north and east of Thunder Bay, Ontario. Large blocks of altered limestone, scattered along logging roads, are made up of closely packed columns with peculiar pointed tops. Where these columns are seen in side view, they look like a series of nested cones, pointing upward. When viewed from the surface, where they are worn away, they appear as concentric rings.

In August 1976 the authors travelled to Thunder Bay to arrange for the collection of particularly fine specimens of this columnar stromatolite. Specimens had been located on a previous expedition, but their dimensions and weight precluded their being collected at that time. In 1976 we had the very generous support of the Great Lakes Paper Company, on whose timber lease these fossils are found. The company provided two trucks, a large tree harvester, and six men. With the finesse of artists, these men, under the supervision of Jack Michaels, were able to mobilize the machine to pick up the stromatolite specimens gently — including a one-ton block — and load them into a truck. They also constructed the necessary shipping crates for the unique specimens and delivered them to the ROM, where the largest block is on display.

The next major development to take place in the Precambrian Era was the evolution of the nucleated cell. With this development came the ability to recombine genetic material through sexual reproduction. From this point on the process of selection for advantageous characteristics could proceed at a much faster rate. Evolution was greatly accelerated. The first fossils of multicellular organisms are found in rocks about 700 million years old, and by about 500 million years ago all the major modern animal groups had appeared... but that's another story.

Robert Barnett joined the ROM *in 1972 on attaining his degree in geology from Carleton University, Ottawa. He is a technician in the Department of Invertebrate Palaeontology, and has had extensive national and international collecting experience. His interest in fossils has led to a study of fossils in myth and legend, and of earliest life forms. A frequent speaker for the* ROM *Saturday Morning Club and the Toronto Junior Field Naturalists, Mr. Barnett is responsible for identifying fossils brought into the museum by the public.*



David Rudkin is a technician in the Department of Invertebrate Palaeontology. As a graduate of the University of Toronto in geology and biology, Mr. Rudkin's primary interests are in Lower Palaeozoic arthropods, and the relationships of fossil organisms with their environments. He has travelled widely in North America collecting fossil material for the reference collections and for research purposes. An active member of the ROM *Speakers' Bureau, Mr. Rudkin attempts to give the public some insight into Ontario's rich geological past.*

Recent Publications

An Annotated Bibliography of the Muskellunge, Esox masquinongy (Osteichthyes: Salmoniformes), ROM Life Sciences Miscellaneous Publication, *E. J. Crossman* and *Cheryl D. Goodchild,* 132 pp., illustrated, $4.50 paper
An invaluable source of available publications for anyone interested in the muskellunge from either a professional or a recreational viewpoint. The body of the bibliography gives complete references for more than 1,000 entries, listed alphabetically by author. This is followed by an index that notes under subject headings each relevant publication with its date and the author's name.

The Trilobites Bathyurus and Eomonorachus from the Middle Ordovician of Oklahoma and Their Biofacies Significance, ROM Life Sciences Contribution 114, *Rolf Ludvigsen,* 20 pp., illustrated, $1.25 paper

Tertiary Mammals of Saskatchewan Part IV: The Oligocene Anthracotheres, ROM Life Sciences Contribution 115, *Loris S. Russell,* 16 pp., illustrated, $1.25 paper

Contemporary Native Art of Canada — The Woodland Indians, 32 pp., illustrated in black and white and colour, $2.50 paper
A historical background to contemporary Woodland art is given in this catalogue, which includes biographies of many well-known Algonkian and Iroquoian artists and illustrations of their work.

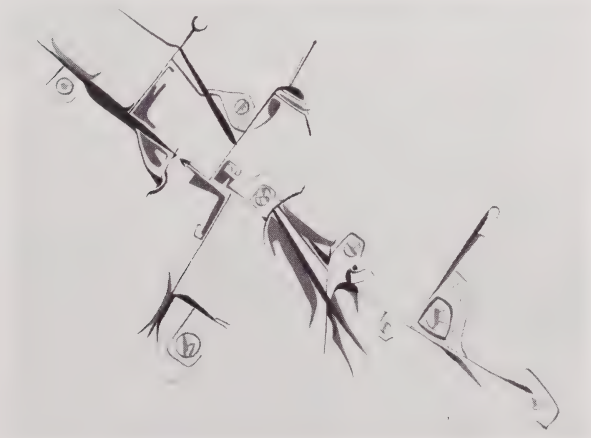
Contemporary Native Art of Canada — The Western Subarctic, 5 pp., illustrated in black and white and colour, $1.25 paper
This brochure is a study of quillwork and moosehair embroidery by five women of Jean Marie River, N.W.T. Detailed description of the quilling process is provided, with illustrations of the finished products.

Contemporary Native Art of Canada — Silk Screens from the Triple K Co-operative, Red Lake, Ontario, 8 pp., illustrated in colour, $1.50 paper
Silk screen prints of six Woodland artists are illustrated in this catalogue, which describes the formation of the co-operative and each artist's work.

Contemporary Native Art of Canada — Alex Janvier, 12 pp., illustrated in black and white and colour, $2.50 paper
A study of the work of Alex Janvier, a Chipewyan painter with a unique style and an international reputation as an accomplished professional.

Quillwork by Native Peoples in Canada, 20 pp., illustrated in black and white and colour, $2.50 paper
A historic approach to the art of porcupine quillwork by Native peoples of Canada, based on museum and private collections. Photographs and drawings illustrate descriptions of quilling techniques and discussion of regional differences in the application of quills. Available in English or French.

The 1978 edition of **ROM Publications in Print** is now available. A free copy can be obtained by writing to Publication Services, Royal Ontario Museum, 100 Queen's Park, Toronto, Ontario M5S 2C6, or by phoning 978-3641.



Untitled watercolour from Contemporary Native Art of Canada — Alex Janvier.

A Country Craft

The Potteries of Grey County

David L. Newlands

THE COUNTRY POTTER at his wheel was as familiar to the inhabitants of rural Ontario in the last century as the supermarket clerk is to us today. Along with a number of other craftsmen, he produced essential items for settlers in the backwoods.

Once the major centres in southern Ontario were established, demand for land in and near them grew and settlement spread. North of Toronto and Hamilton, it spread into the county of Grey, which borders southern Georgian Bay. With the migration of people into the county, new villages and hamlets sprang up, and it was in these small communities that the potter set up his workshop, with the characteristic kiln and pug-mill. Potteries, though never very numerous, were located near supplies of clay and water and within reasonable distance of larger centres of population. In all, small potteries were founded in six communities in Grey County. Their history reflects the nature of the potter's craft and illustrates the range of earthenwares produced in the county.

The hamlet of Kilsyth in Derby Township, about five miles south of Owen Sound, was the site of the first pottery in Grey County. In 1858 George Smith moved from Desboro in Sullivan Township to Kilsyth, and for a fee of $30 a year leased part of lot 10, concession 7. The terms of the three-year lease specified that the property was to be used only for a pottery. Two years later Smith purchased land, a one-acre tract near the hamlet, and set up a pottery on it.

In April of 1864 William Walmsley and James McCluskie entered into a pottery partnership in Kilsyth, apparently in association with George Smith, although documentary evidence is not precise. A county directory for the years 1865/66 describes the partnership's operation thus: "The earthenware manufacture of Walmsley & McCluskie has attained considerable proportions, the pottery having now been in successful operation for several years; and many articles of the more ornamental kinds, as well as those in common use, are now produced at the works."

Walmsley and McCluskie did not remain in partnership very long: in 1866 Walmsley sold his interest to Alexander Brady, and subsequently McCluskie sold his to George Smith. Brady, too, soon left the company, presumably before 1869, for in that year George Smith leased the entire business to Alexander Sinclair—for $100 a year. The pottery was then known as the Derby Pottery, a name it retained until its closing in the autumn of 1909.

In 1871 Alexander Sinclair bought the Derby Pottery for $400 and operated it in conjunction with a small farm. A note in the census of 1870/71 indicates the scope of the enterprise: Sinclair had $1,000 invested in the business, employed four male hands at a total yearly wage of $1,000, and had an annual output of $2,000 worth of pottery. During Sinclair's tenure a number of craftsmen were employed in his workshop, including John Horning, who was later to be in partnership with Samuel Brownscombe in Owen Sound, and Robert Wallace, who later established a pottery at Millbank in Perth County.

A Derby Pottery price list is now in the possession of Alexander Sinclair's grandson. The range of wares advertised illustrates the utilitarian nature of most of the articles turned out in country workshops. Unlike modern art potteries in Grey County, which cater for the tourist trade or the

Examples from the ROM *collection of pottery made at the Owen Sound Pottery Co. between 1895 and 1907. The pieces are made of red clay (redware), covered with a cream slip and adorned with a brown slip decoration, often in the form of intertwined flowers.*

DERBY POTTERY

KILSYTH P. O.

190

Bought of **ALEX. SINCLAIR,**

Manufacturer of all Kinds of POTTERYWARE.

TERMS.—33⅓ PER CENT. DISCOUNT FOR CASH ON DELIVERY.

Richardson Printer, Owen Sound.

Doz.		$	C
	CREAM POTS.		
		Per Doz.	
	6 Gallon	$6 00	
	4 "	4 20	
	3 "	3 00	
	1 "	1 50	
	½ "	0 84	
	BUTTER POTS (with covers)		
	4 Gallon	$6 60	
	3 "	5 40	
	2 "	4 20	
	1 "	2 40	
	CHURNS.		
	6 Gallon	$12 00	
	5 "	9 00	
	3 "	5 00	
	MILK CROCKS.		
	2 Gallon	$2 40	
	1 "	1 50	
	½ "	0 84	
	MILK PANS.		
	2 Gallon	$2 16	
	1 "	1 20	
	PRESERVE JARS (with corks).		
	1 Gallon	$2 40	
	½ "	1 80	
	¼ "	1 20	
	TEA POTS.		
	1st size	$4 50	
	2nd size	3 60	
	FLOWER POTS (with stands).		
	1 Gallon	$2 40	
	½ "	1 80	
	¼ "	1 20	
	1 pint	0 84	
	½ "	0 60	
	Carried forward.....$		

Doz.		$	C
	Brought forward.....$		
	HANGING BASKETS.		
		Per Doz.	
	½ Gallon	$3 00	
	¼ "	1 80	
	MOLASSES Jugs.		
	2 Gallon	$4 20	
	1 "	3 00	
	½ "	1 80	
	¼ "	1 50	
	JUGS.		
	2 Gallon	$4 20	
	1 "	3 00	
	½ "	1 80	
	¼ "	1 50	
	WATER PITCHERS.		
	1 Gallon	$3 00	
	½ "	2 40	
	¼ "	1 50	
	STOVE TUBS.		
	12 inches long	$3 00	
	8 "	2 40	
	5 "	1 50	
	CHAMBERS.		
	1st size	$3 00	
	2nd size	1 80	
	SPITTOONS.		
	1st size	$9 00	
	2nd size	6 00	
	3rd size	3 60	
		$	
	Discount		

Received Payment.....$

ORDERS BY MAIL RESPECTFULLY SOLICITED.

decorative art market, the country pottery of the last century produced mainly vessels to be used in preparing, canning, and storing food.

The Derby Pottery was housed in a two-storey stone structure, set back from the main road of the village. After the workshop ceased to function in 1909, the building was used for storage. It remained a local landmark until June 1971, when the then-owner had the roof burned off and the rest of the building demolished. A photograph taken while demolition was in progress bears mute testimony to the irreversible loss of what is believed to have been the only remaining 19th-century pottery in Ontario. The site on which it stood is now the front lawn of a modern house.

During part of the 19th century there was one other pottery in Kilsyth. It was owned by John Spilka. The census of 1860/61 indicates that the business was located on a two-acre plot, presumably near the hamlet. It could not have been very successful, however, as by 1868 Spilka had moved to Owen Sound, where he established the first pottery in that commercial centre.

After George Smith sold the Derby Pottery, he returned to Desboro, where he extended his interests to include an inn, a store, and a pottery. The pottery operated from 1873 until about 1882 and was located on the northeast corner of lot 13, concession 8, where the kiln was reported intact as late as 1975. Smith's grandchildren still have pieces of his pottery, but unfortunately none is marked or stamped with an identifying symbol or name that would verify its association with the Desboro site.

John Kuehner, a potter who had emigrated from Germany in the 1850s, first plied his trade in Waterloo County, a centre of "Germanic tradition" pottery. In 1865 he moved to Hanover in Bentinck Township, where he established a business on land leased from Henry Adams—a one-acre site known as lots 10, 11, 12, and 13, on the east side of Victoria Street. After his death two years later, his widow, Sophia, purchased the lots and continued to operate the pottery,

Opposite page: Price list of the Derby Pottery, dated between 1900 and 1909. (Courtesy Mr. Don Witherspoon, Kilsyth).

Below: The Derby Pottery building in the process of demolition in 1971.

with the help of her sons Conrad and Lewis. The census of 1870/71 reported that the pottery employed one male hand at a yearly wage of $200 and produced $450 worth of pottery. Production was discontinued in 1876. When Sophia Kuehner died in 1884, she left the property to her son Conrad, who by this time had moved to Michigan. The Kuehners did not mark their wares and no pottery is known that can be attributed to the Hanover workshop.

In 1882 Edwin Bradwin established a pottery near Egremont in Normanby Township; it was his third business venture and remained in continuous operation until his death in 1917. Edwin Bradwin grew up in Paris, Ontario, where he learned his trade from either Jacob H. Ahrens or John Marlatt, both well-known craftsmen. Although Edwin was just a teenager when his father died, he and his brother Joseph had to go to work to support their family. In 1866 the two brothers founded a pottery in the village of Lynden in Wentworth County. Edwin moved to Mount Forest in 1873 and set up his second workshop. Four years later Joseph joined him, but by 1881 he had moved west to Wingham in Huron County. The exact reason for Edwin's shift a year later from Mount Forest to Egremont—just three miles north—is not clear, but it may have been the abundance of clay on the Egremont site that attracted him.

In the summer of 1977, I visited the Egremont site and was able to find the remains of two kilns. The earlier kiln was situated inside the lot, with a winding route leading from it to the road. The later kiln was situated beside the road, now Highway 6, and was destroyed by the grading and re-routing of the highway.

In Sydenham Township, John and James Lemon established a small pottery in the village of Woodford in 1873. It was on part of lot 4, concession 1, north of the centre-line road, and a recent history of Grey County records that it produced milk pans, pitchers, flower pots, and bricks. Later, John Lemon purchased a parcel of land bordering Georgian Bay, and another in Owen Sound—lots 7 and 8 on Stephen Street, north of Front Street (the streets are now known as 1st Avenue W., north of 10th Street W.). Documentary evidence for the history of the Lemon business is not clear. Activity in Owen Sound ceased in 1896, but Lemon owned the Georgian Bay property until late in 1899. It may be that he operated two potteries (but that would have been unusual), or that he produced pottery on the Georgian Bay site and sold it in his Owen Sound premises. The second theory is partially supported by the fact that the credit-rating agency of Dun, Wiman & Co. continued to report on a Lemon pottery until the year the sale of the Georgian Bay property was completed.

Owen Sound became the centre of pottery making in Grey County. The first workshop in the town was John Spilka's, but its exact location is unknown, since he did not own land. A county directory for the year 1865 places the pottery on "Park lots, east of town";

a listing of 1871 puts it "off Garafaxa Rd." Both descriptions are too vague to be of help to the field investigator, but wherever the pottery was located, it seemed to thrive. The census for the years 1870/71 reported that John Spilka had $40 invested in the business, which operated for six months of the year and employed three potters at a total wage of $300. During the year 1870 the pottery turned out 1,800 pieces of earthenware valued at $1,500.

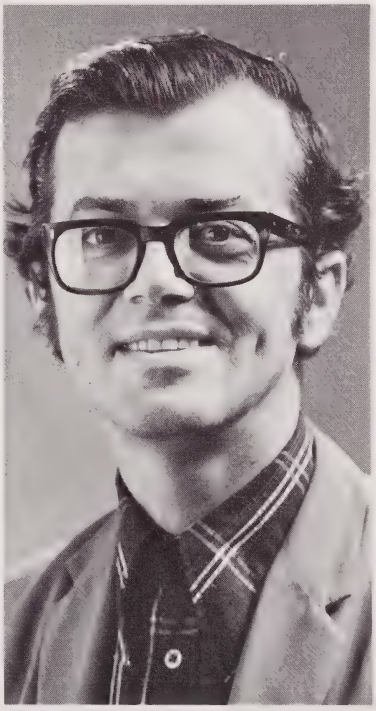
In September of 1895 John Horning and Samuel Brownscombe went into partnership to form the Owen Sound Pottery Co. John Horning had worked at the Derby Pottery in Alexander Sinclair's time, and Samuel Brownscombe had pursued his craft for a time in Bruce County. The potter's life in the last century seems to have been a peripatetic one. Wages were low and many potters endured a marginal existence. When prospects seemed brighter farther afield, they moved.

Until its closing in 1907, the Owen Sound Pottery Co. produced a wide assortment of household wares, some of which were covered in a cream slip and then decorated with flowers in a brown slip — an imitation of porcelain with a distinctly pioneer flavour. Of the more than 80 potteries in Ontario in the 19th century, only the Owen Sound Pottery Co. produced highly individualized pieces. Although the pottery was not marked, we know something about the origin of these distinctive wares from the recollections of Samuel Brownscombe's daughter Laberta, for whom he produced a number of miniature pieces.

The closing of the workshop at Egremont in 1917 marked the end of the country potteries of Grey County. A new generation had become accustomed to inexpensive porcelain, glass jars, and tin household containers. In recent times potteries have once again appeared in Grey County. Although they cater for tourists and art pottery interests, and their wares are very different from those of the last century, the new potteries represent a very interesting modern development.

David Newlands is Lecturer and Co-ordinator for the Museology Programme at the ROM. *Prior to his appointment in Museology, he was Curatorial Fellow at the Canadiana Department, where he pursued an active programme of historical archaeology in Ontario. He has excavated at three 19th-century pottery sites (two in Ontario and one in New York State), and at historic Fort York, Toronto. Mr. Newlands frequently writes articles on archaeology and Ontario potteries for magazines, and is now preparing a major study of the 19th-century potteries of Ontario. He is senior author of* An Introduction to Canadian Archaeology, *published in 1976 by McGraw-Hill Ryerson, Toronto.*

Above: Miniature pottery pieces made by Samuel Brownscombe for his daughter Laberta. Miniatures were often used as gifts and salemen's samples.



Opposite page: Horning & Brownscombe's Owen Sound Pottery Co. building in the late 19th century. It was located on the south side of Baring Street E., just east of Murdoch Street, now 7th Street E. and 4th Avenue E. (Courtesy Mrs. Laberta Fralic).

Above: Crucified Christ by Johann Gottlob Kirchner, Meissen, c. 1730. The Virgin Mary (or Mary Magdalene?) and St. John the Evangelist from a crucifixion group by Johann Joachim Kaendler, Meissen, c. 1740–1742.

Right: Chinese Woman and Child, here attributed to Peter Reinicke, Meissen, c. 1748.

Opposite page: Meissen saucer with Augsburg gilt chinoiserie decoration of the type associated with the Seuter workshop, c. 1730–1735.

K. Corey Keeble

Early Meissen Porcelain

For the Pleasure of Princes

FOR HUNDREDS OF YEARS Europeans knew of the existence of an impermeable, shiny white, translucent material that came from the Far East. Marco Polo saw it on his famous visit to China in the last decade of the 13th century and compared it to the cowrie shell, which in the Italian vernacular was called *porcella* (little pig). He dubbed the wondrous material *porcellana* and the name stuck — to become *porcelaine* in French, *Porzellan* in German, and *porcelain* in English.

Developed by the Chinese as early as the period of the T'ang Dynasty (A.D. 618–906), porcelain is composed of a mixture of nonfusible aluminum silicate in the form of a fine white plastic clay called kaolin and a fusible aluminum silicate in the form of pulverized feldspathic rock called petuntse. At a temperature of 1300°C to 1400°C, petuntse fuses and binds the kaolin to produce a white, translucent, vitrified ceramic material that is so hard that a knife will not scratch it. Europeans prized porcelain for its translucency, but one of its characteristics most valued by the Chinese was its resonance — porcelain vessels when they are struck emit a clear, bell-like sound.

Small quantities of Chinese porcelain found their way to Europe during the Middle Ages and the Renaissance, and increasing amounts began to appear with the voyages to the Far East of the Portuguese, Dutch, and English in the 16th and 17th centuries. Among the European aristocracy the collecting of Oriental porcelain became a virtual mania. By the late 1600s and early 1700s some palaces in Europe featured special rooms for the display of porcelain, such as the "porcelain room" of 1703 in the Charlottenburg Palace in Berlin, designed for the accommodation of a great collection of Oriental decorative wares.

Attempts to duplicate porcelain on European soil — or perhaps it would be more precise to say *of* European soil — failed repeatedly. As early as the last quarter of the 16th century a soft-paste imitation porcelain was turned out at a Medici factory in Florence, and

similar imitations were made in France in the course of the 17th century, but it was not until the first decade of the 18th century that a successful duplication of Eastern, or hard-paste porcelain was achieved in Europe.

Credit for the solution of a problem that had perplexed Europeans for centuries goes to an itinerant alchemist named Johann Friedrich Böttger (1682–1719). Böttger, who by all accounts was something of a rogue, fell afoul of the King of Prussia, Frederick I, and the Elector of Saxony, Augustus the Strong, who demanded that he prove his claim to be able to transform base elements into gold. Böttger's virtual imprisonment by Augustus the Strong (so called, it would seem, because of his alleged siring of no fewer than 354 children, of whom only one was legitimate) brought him into contact with Ehrenfried Walther von Tschirnhaus (1651–1708), who had been trying for many years to unlock the secrets of the composition of true or hard-paste porcelain. His researches were prompted in part by the vast expenditures made by Augustus on his own collection of Oriental porcelain (Augustus was so obsessed with his porcelain collection that he once bartered a regiment of Dragoons for a set of vases). If porcelain could be made in Saxony, Tschirnhaus reasoned, such expenditures would be unnecessary, and, in good mercantilist fashion, Saxony could build up its own porcelain industry.

Tschirnhaus succeeded in having Böttger's skills applied to research on porcelain, and by 1708 Böttger had produced both an extremely hard red stoneware, similar to the Yi-Hsing wares of China, and his first examples of white porcelain of Chinese type. By 1709 he had developed a satisfactory white porcelain and an appropriate glaze. The result was the establishment in 1710 of the Royal Saxon Manufactory, the first of its kind in Europe. It was set up in the Albrechtsburg fortress at Meissen.

The first products of the factory were pieces of Böttger's red stoneware, and as might be expected they were derivative: vessels copied directly from Chinese originals or from works in silver by the court silversmith Johann Jacob Irminger. Among the stoneware objects were teapots, tankards, vases, and pilgrim flasks. Their colour ranges from reddish to brown, although some pieces appear to be black, owing to the presence of a shiny glaze over which decorations in gold were sometimes painted.

White porcelain was not in regular production at Meissen until 1713. Among the early pieces are garnitures or sets of covered vases, with gadrooned lids, applied leaf decoration around the lower circumference, and rectangular tab-shaped sections in relief, derived from the lambrequin designs found every-

Above: Böttger red stoneware pilgrim flask with applied masks, gadrooning, and faceted decoration. Based on designs for silver, Meissen, c. 1715.

Right: Höroldt chinoiserie saucer with gilt scrollwork and cartouche in gold and iron-red, Meissen, c. 1724.

where in Baroque art.

Oriental shapes are equally common in Böttger porcelain, again with decorations in relief, often in the form of prunus branches. Relief decoration on some early white wares produced about 1720 was gilded and touched up with enamel colours, but examples are extremely rare.

With the successful development of both a red stoneware and a white porcelain, Böttger turned his efforts to the production of satisfactory colours for the decoration of his white porcelain. But the perfection of a whole range of colours and the real development of painted decoration belong to the next phase in the evolution of the factory.

Throughout the 1720s the dominant influence on Meissen's artistic destiny was that of Johann Gregor Höroldt (1696–1776). Höroldt had been trained as a miniaturist and enamel painter and had worked for a short time at the new porcelain factory at Vienna before coming to Meissen, where his ascent was rapid. His goals at Meissen were to improve the range of colours used in decorating porcelain and to create new and original styles of decoration. With the assistance of David Köhler, he succeeded in the first task. An array of test pieces dating from 1726 to 1727 illustrates the progress the factory made in widening the Meissen spectrum. Among the colours developed were a biscuit shade, numerous shades of yellow, three shades of emerald green, a sea green, pale grey and lilac shades, lavender, and crimson purple — to augment the lilac blue and apple green already produced by 1725.

Höroldt's principal claim to fame, however, was his achievement of a highly original style of decoration in the form of his renowned chinoiseries — groups of stylized Chinese figures placed in landscapes enclosed by shaped cartouches and highlighted with strapwork and foliage scrolls. These designs are not strictly speaking "Chinese", but instead conform to a European fantasy of the Orient.

Höroldt's talent for organization enabled him to impose a uniformity of design over the entire factory, so that it is virtually impossible to recognize individual hands in the execution of the designs — they seem to have been produced by a workshop method that anticipated the assembly line. The quality and execution of the design, however, are unsurpassed in the history of European porcelain and make Meissen wares of the Höroldt period unique.

About 1726 Höroldt introduced another form of decoration, which became as popular as his chinoiserie designs—scenes of Turkish and European merchants standing on the shores of ship-filled harbours. Many of the chinoiserie and harbour scenes were contained within cartouches, with a white ground out-

Above: Böttger porcelain covered vase, the shape derived from designs for silver, Meissen, c. 1715.

Left: Tea-caddy with European figures in a landscape enclosed in an elaborate cartouche of gilt scrolls outlined in black. On the end panels are harbour scenes; on the front are trompe-l'oeil *painted insects. Meissen, c. 1735–1740.*

side, but more and more use was made of coloured grounds, particularly after 1730. By 1735 Höroldt's chinoiseries had taken second place to landscapes and hunting scenes influenced by French engravings, which were followed by hunting and battle scenes based on Rugendas engravings and peasant scenes modelled on earlier works by the Teniers family. Moving towards 1740 there was a tendency to greater naturalism in the decorative schemes, evident in the scenes within the cartouches, in which the flatness and stylization of earlier works was increasingly replaced by *trompe-l'oeil* effects.

Among the most brilliantly executed painted wares of the Höroldt period at Meissen were those that emulated the Kakiemon wares of Japan, developed at Arita in the 17th century. Examples of this beautiful Japanese porcelain found their way into the collection of Augustus the Strong and were housed in his famous Japanese Palace. To decorate the palace, Augustus had the Meissen factory copy Kakiemon pieces, and the results were very successful. Unmarked Meissen copies are hard to distinguish from the originals, although the decorative designs of the replicas seem to be sharper, more precise, more rigid, and somehow colder. Meissen versions of Kakiemon porcelain borrowed not only the designs but also the shapes of the original vessels—octagonal bowls, square-sectioned sake bottles, and hexagonal vases.

Although Höroldt was no doubt involved in the production of Kakiemon wares, the style is most closely associated with Adam Friedrich von Löwenfinck (1717–1754) and Johann Stadler. The decoration of the Kakiemon porcelains featured slender, stylized groups of flowers, leaves, and prickly branches, executed in red, green, and blue. One common motif was a phoenix perched on an angular linear array of pine and prunus branches. The sparseness and simplicity of the designs are

compelling. As well as the phoenix, other bird-like motifs were used, as is evident in a cup and saucer of about 1730 to 1740 in the ROM's European Collection (the saucer is illustrated). There were also animal motifs, such as the famous red dragon in constant use at Meissen from 1734 to about 1744. Von Löwenfinck evolved his own unique version of these motifs in an array of *Fabeltieren*, fabulous hybrid beasts that wander across the surfaces of the porcelain he decorated. They include creatures that are part dragon, part deer, and half horse, set in the midst of clusters of bristly Kakiemon flowers.

Many of the Meissen Kakiemon designs appeared initially on white porcelain. Often, however, the background was enclosed within a cartouche, which was surrounded by a coloured ground. Coloured grounds were associated with Kakiemon wares at the Meissen factory from an early date and were used increasingly through the 1730s and 1740s.

The Meissen Kakiemon style influenced the designs of a number of other European porcelain factories, notably the ones at Chantilly in France and Chelsea in England. The normal palette for the designs was black for the outlines, with an infilling of turquoise green, soft yellow, sky blue, and iron-red.

The painterly phase at Meissen, initiated by Höroldt in the 1720s, was followed in the thirties by a period in which the factory evolved a sculptural style. Actually, earlier attempts had been made, and under Böttger's aegis a number of sculptural works were produced both in his red stoneware and in white porcelain. These pieces included casts taken from ivory and bronze statuettes and medals, as well as copies of Chinese Kuan Yin figures. Among the subjects chosen for imitation were relief medals of Peter the Great of Russia and Frederick I of Prussia, a statuette of Augustus the Strong in armour, a head of the Emperor Vitellius after a Roman original, an Apollo head based on a work by Bernini, and statuettes of Italian *commedia dell'arte* figures, all in stoneware. Some of these must have been made as early as 1710 and were included in the Meissen inventory of 1711.

In the 1720s, when the dominant interest of the factory was painted wares, some small sculptural pieces were produced: seated Chinese figures called Pagods and figures of dwarfs based on designs by Callot. Many of these have been attributed to Georg Fritsche, who was employed at the factory between 1712 and 1732, and although they are naive and indeed crude, they are less strictly derivative than the earlier casts.

The real impetus for a Meissen sculpture style came with Augustus the Strong's determination to decorate the Japanese Palace. He wanted to achieve in porcelain what Louis XIV had achieved in silver at the Palace of Versailles. His plans called for the provision of no fewer than 25,215 separate pieces—all of porcelain, including the decorations for the throne room and the chapel.

To work on the project Augustus employed the sculptor Johann Gottlob Kirchner as modeller in 1727, but Kirchner's activities at Meissen were

Opposite page: St. John Nepomuk, by Johann Gottlob Kirchner, Meissen, c. 1731.

Left: Saucer in Kakiemon style (shown here without its accompanying cup), Meissen, c. 1730–1740.

sporadic: he was dismissed in 1728, reinstated in 1730, and dismissed again in 1733. In 1731 the sculptor Johann Joachim Kaendler (1706-1775) was also employed to work on the project, and it was he who became the prevailing force in the development of a Meissen sculpture style—and with him Meissen was firmly linked to the mainstream of European Baroque art.

Kaendler was a pupil of the sculptor Benjamin Thomae, who was in turn an associate of the leading early 18th-century sculptor of Saxony, Balthasar Permoser (1651–1732). Permoser had brought to Saxon sculpture not only the qualities of the Southern Germanic schools of sculpture — he was a native of Salzburg—but also those associated with the art of the Italian Baroque. Kaendler, who had been exposed to the Permoser style, thus carried the influence of some of the most powerful currents of Baroque style from the world of sculpture, architecture, and architectural sculpture into the world of hard-paste porcelain. In so doing, he effectively levelled whatever barrier is believed to exist between the "fine" and the "decorative" arts.

At Meissen Kaendler was charged with the design and execution of life-sized figures of animals for the decoration of the Japanese Palace, as well as of life-sized figures of the Apostles for its chapel. The project was a failure. The kilns of the period could not accommodate pieces conceived on so grand a scale, and many of the figures were ruined by cracks and fissures that occurred at the time of firing. Some of them have survived, however, and they illustrate the fundamental difference between Kirchner and Kaendler in their approach to porcelain as a medium for sculpture. Kirchner's approach was the more superficial and he seems not to have grasped the full potential of porcelain. His works are characterized by an overall flatness and are without deep shadow. His animal figures derive from engravings and have a fantastic quality — far different from the quality of Kaendler's figures of eagles, a Paduan cock, a Bolognese dog, and goats, which clearly reveal that they were modelled from nature. Kaendler's figures were brilliantly conceived, and from the beginning they were marked by superb modelling and detail and by an effective balance of solid and void, which creates a glorious play of light and shade over the entire surface of the figure.

With the demise of the project for the Japanese Palace, Kaendler turned his attention to figures on a smaller scale. In the years between 1735 and 1741 he designed sculptural decoration for a number of important Meissen table services, including the Sulkowsky service of 1735 to 1737 and the Swan service of 1737 to 1741. The latter, created for the commissioner of the factory, Count von Bruhl, consisted of no fewer than 2,200 pieces, with sculptural decoration emphasizing an overall water motif. Tureens and other vessels were adorned with figures of swans, dolphins, sea gods and goddesses, and shells; plates received a shallow relief treatment that gave the effect of waves. From Kaendler's table services there derived an almost endless array of individual and group figures on a small scale. Many of them were intended to be table decorations — porcelain replacements for the statuettes in wax, sugar, or marzipan that by custom adorned banquet tables.

Kaendler's independent figures deserve to be considered as individual works of art, the 18th-century equivalent of the small Renaissance bronze. In their own right they are the equal of sculptural work in any medium by any major sculptor of the 18th century. They include figures of animals, in effect reductions of the models for the Japanese Palace, made as early as 1734.

The figures meant to decorate the chapel too were scaled down. Between 1735 and 1741 Kaendler produced statuettes of the Apostles, an altar with a crucifix, and other small figures, including a St. John the Evangelist and Virgin Mary, which bear indisputable witness to the brilliance of his modelling style. The draperies are rendered in such a way that they lend the figures a powerful sense of mass and depth, and in addition heighten the tension and emotion that pervade them. The figures are monumental in scale and would lose nothing if enlarged to many times their size.

Kaendler's Virgin and St. John provide a contrast to a figure of the crucified Christ attributed to Kirchner and conceived in very different terms. The modelling of the Christ displays the flatness and lack of articulation and definition typical of Kirchner's work. In Kaendler's figures even the draperies help to create an effect of depth and articulation, so that the precise details of the anatomy of the bodies under the draperies are suggested. Interestingly, Kirchner's abilities were not always frustrated by porcelain: they were realized in a few statuettes attributed to him, notably a powerful figure of St. John Nepomuk, which seems imbued with the spirit of the Italian Baroque.

Working with Kaendler, and thoroughly influenced by his style, were a number of gifted assistants, including the brilliant young sculptors Peter Reinicke and Johann Friedrich Eberlein. It is probable that Reinicke was responsible for the design of the small group "Chinese Woman and Child" recently acquired by the ROM. It is supposed to date from as early as c. 1725 to 1730, but in fact its modelling is too accomplished for that early date; the precision of the rendering of such details as the folds of the drapery would have been virtually impossible without the influence of Kaendler. The drapery and the form of the base are strongly reminiscent of the

Bolognese dog by Johann Joachim Kaendler, Meissen, c. 1770.

work attributed to Reinicke, such as the figures representing "Different Nations of the Levant", which appeared about 1748.

Kaendler continued working at Meissen well into the second half of the 18th century, but he never really adapted to Rococo and Neoclassical styles, and remained at heart an artist of the Baroque, and a somewhat sardonic one at that. Many of his figures seem to be expressions of an artist with an uncommonly biting wit. He was no sentimentalist, and his best works, such as his Italian comedy figures and some of his groups of lovers, have a gritty, almost earthy quality, which is matched by the robustness of his modelling style. He could, however, produce works of perfect charm. One of his late compositions — a group of Bolognese dogs dating from as late as the seventies — returns to a subject of an earlier period, and has all the flash and verve of his very best work of the period before the Seven Years War (1756–1763).

The Seven Years War terminated the early development of the Meissen factory. Prussian troops invaded the city, and the work of the factory was completely disrupted—a disruption that was almost prophetic. After the war, taste shifted to the gentler Rococo, and Meissen ceased to enjoy its earlier monopoly, for by that time several factories had been formed in Germany. Other porcelain works (although they produced soft-paste porcelain) had been established in England, and the great factory at Sèvres was just beginning to exert its influence on European taste.

Virtually all histories of the Meissen factory refer to a special class of porcelain that though made at Meissen was not decorated there. In the early years of the factory, before the technical processes were perfected, there was a considerable incidence of damaged or defective pieces. These were not destroyed but were sold to independent decorators called *Hausmaler*. In the early 1720s the amount of porcelain released to these outside decorators increased considerably and the wares decorated by the *Hausmaler* began to compete with those finished at the factory—to such an extent that in 1723 the factory was forced to adopt a distinctive mark by which its own wares could be identified. The mark was the famous blue crossed swords, and it has continued in use to the present day.

It is not surprising that the factory felt compelled to protect its wares against the competition of the works of the *Hausmaler*. Although some of the independent painters were mere hacks, others were artists and craftsmen of great originality and competence. Many *Hausmaler* worked in Dresden, but they were active in other cities as well, including Augsburg, Breslau, Pressnitz, and Bayreuth. In fact, they had decorated faience and glass before the advent of porcelain, and they worked not only on Meissen porcelain but also on porcelain imported from China. When a

second European porcelain factory was opened at Vienna, its wares too found their way into the hands of the *Hausmaler*.

Among the best-known *Hausmaler* were those at Augsburg, particularly the members of the Seuter and Auffenwerth families. Recent literature on Meissen suggests that some of the most characteristic works of the Seuter family were gilt chinoiseries, in which the designs were in silhouette, with finely engraved details. Many of these bear such a strong resemblance to the designs of Höroldt that it was once believed that gilt chinoiseries were done within the Meissen factory—a view that persisted until challenged by S. Ducret and A. Torré in the late 1960s.

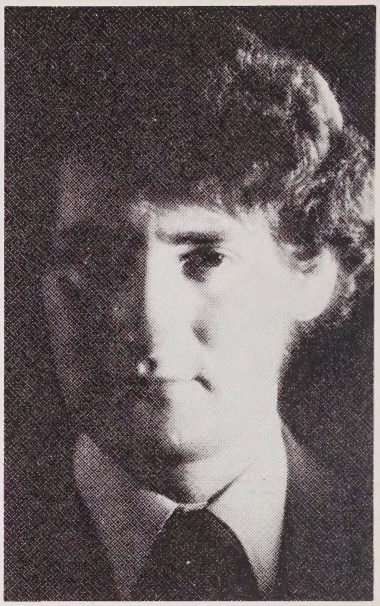
That many of the gilt chinoiserie designs done at Augsburg should be reminiscent of Höroldt's designs is not extraordinary. Bartolomäus Seuter (1678–1754), one of the leading practitioners of gilt chinoiseries, had in fact worked at the factory and must have been well acquainted with Meissen styles. Moreover, he came from a family of goldsmiths and engravers, and the relationship between Augsburg goldsmiths and the Meissen factory was close, owing to the factory's use of silver or silver-gilt mounts for many of its major pieces. Seuter is now known to have signed examples of porcelain decorated with gold silhouette chinoiserie designs, and an engraved portrait of him is known, in which there are examples of gilt chinoiseries ranged on a shelf behind him.

Many of Seuter's designs feature a typically Baroque touch in tight borders composed of C-shaped scrolls. These are similar to borders used at Meissen and are part of the general vocabulary of form utilized by Baroque craftsmen in Germany. They appear not only on porcelain, but on silver and furniture, and in engravings of architectural designs—another instance of the typical Baroque synthesis, in which differences between the fine and applied arts are often obliterated.

The *Hausmaler* of Augsburg and Dresden were rivalled by those of Breslau, and two Breslau decorators have a lasting claim to fame: Ignaz Bottengrubber, who was active from about 1725 to 1735, and Ignaz Preussler (b. 1676). Before he turned to the decoration of porcelain, Bottengrubber painted miniatures and watercolours. In the 1720s he decorated Meissen porcelain, but he also decorated Chinese and Vienna porcelain.

Preussler's work bridged several fields. He came from a family of Nuremberg painters who specialized in the decoration of glass and pottery, and he turned the monochrome technique for glass to the decoration of porcelain, both Meissen and Vienna wares. He took his subjects from engravings, but he was in no way a mere copyist. Instead he assimilated ideas from the engravings and transformed them into remarkably fresh compositions of his own. His best-known works are executed in iron-red or black monochrome, or characteristically a combination of both in a design that occupies virtually the entire surface of the piece of porcelain. Preussler's technique makes him one of the most memorable of all the 18th-century *Hausmaler*.

By the middle years of the century, the number of porcelain factories had increased significantly, and Meissen no longer had the only European factory producing hard-paste porcelain. Gradually the market for porcelain decorated by the *Hausmaler* was eroded, and by the 1750s their importance had waned. From the opening years of the Meissen factory to the middle years of the 18th century, however, their work constituted an important sphere of artistic endeavour. Today much of it is valued as highly by collectors, connoisseurs, and historians as the very best pieces decorated within the Meissen factory.



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